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MAY 1988

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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W88-03493 -- W88-04484

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988 .

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

CARBONATE CHEMISTRY OF AQUATIC SYSTEMS; VOLUME 2: HIGH SALINITY WATERS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
R. E. Loewenthal, and G. R. Marais.
Butterworths, Boston. 1984. 501 p, 4 suppl.

Descriptors: *Water softening, *Hydrogen ice concentration, *Model studies, *Computer models, *Salinity, Acidity, Alkalinity, Acid water, Carbonates, Ions, Computer programs, Theoretical analysis, Aquatic environment, Chemical properties, Chemical reactions.

This book forms a companion volume to the one published in 1976 entitled Carbonate Chemistry of Aquatic Systems. Whereas that volume dealt with carbonate chemistry of low salinity waters, for ionic strengths up to about 0.05 this volume extends the theory to high salinity waters for ionic strengths up to about 5. The object of this work is to develop, from a sound theoretical basis, a model for the carbonate system structured in such a fashion that it can be applied readily in the solutions to a wide variety of problems involving this system in the aqueous-gaseous-solid phases. Topics covered in this volume under non-associated binary electrolytes are hydration, partial molal volumes, units of concentration, activity and activity coefficients, modeling of mean and single ion activity coefficients in binary systems, and activity of the water component. Topics covered under non-associated mixed systems are mean activity coefficients, mean activity coefficients where ionic association occurs, verification of mixed electrolyte theory, and activity of the water components in mixed systems. Various topics are covered in chapters on pH and weak acid-base systems, phase equilibria, three-phase equilibria, and application to water softening. Four computer programs - activity coefficients, distribution of weak acid species and subroutine ACTIVE, single-phase conditioning diagrams, and modified Caldwell-Lawrence diagram - are included in supplements to the book. (Geiger-PTT)
W88-03949

EFFECT OF CHEMICAL COMPOSITION OF WATER ON HENRY'S LAW CONSTANT,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5A.
W88-04197

2. WATER CYCLE

2A. General

WEATHER RADAR AND WEATHER RADAR PROCESSING SYSTEMS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 7B.
W88-03635

EVALUATING PARTIAL AREAS OF WATERSHED RUNOFF,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2E.
W88-03785

SELECTED PAPERS IN THE HYDROLOGIC SCIENCES, 1985.
Geological Survey, Reston, VA. Water Resources Div.
Available from Supt Doc, USGPO, Wash, DC 20402. USGS Water-Supply Paper 2270. 119 p. S. Subitzky, editor.

Descriptors: *Hydrology, *Geohydrology, *Water quality, *Path of pollutants, *Water resources research, *U.S. Geological Survey.

Selected papers in the Hydrologic Sciences is a new journal publication aimed at meeting widespread public and professional interests of the hydrologic community for timely results on hydrologic studies derived from the Federal research program, and the Federal-State cooperative program of the U.S. Geological Survey. Also included will be results of some studies done on behalf of other Federal agencies. This second volume of the Selected Papers series, comprising nine topical papers, addresses an array of topics including model simulation of ground- and surface-water systems, hydrochemistry, biochemistry of aquatic environments, and selected physical and chemical techniques on hydrologic studies. (See W88-03885 thru W88-03893) (USGS)
W88-03884

ESTIMATION OF SURFACE MOISTURE AVAILABILITY FROM REMOTE TEMPERATURE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 7C.
W88-04101

REAL-TIME FLASH FLOOD PREDICTION,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-04104

TAYLOR'S HYPOTHESIS AND DISSIPATION IN RAINFALL,
Mississippi Univ., University. Dept. of Civil Engineering.
V. K. Gupta, and E. Waymire.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9657-9660, August 1987. 20 ref. Army Research Office Grant 21078-GS and National Science Foundation Grant CEE 8303864.

Descriptors: *Hydrologic models, *Scaling, *Statistical methods, *Rainfall, *Taylor's hypothesis, *Stochastic process, Spatial distribution, Temporal distribution, Model studies, Theoretical analysis, Mathematical studies.

The role of dissipation in the cutoff in Taylor's hypothesis for rainfall correlations in space-time is generalized to a wide class of possible stochastic rainfall models. Some important implications of this generalization are discussed for the development of statistical rainfall theories, particularly as they pertain to scaling. A stochastic partial differential equation is identified which in its general form is satisfied by several models introduced in the literature. This equation provides a phenomenological basis for introducing the notions of dissipation and generation in stochastic rainfall models. Finally, the respective roles of dissipation and generation are analyzed for the cutoff in Taylor's hypothesis in a wide class of possible rainfall models. (Geiger-PTT)
W88-04107

APPLICATION OF SPATIAL POISSON MODELS TO AIR MASS THUNDERSTORM RAINFALL,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W88-04108

ASSESSMENT OF A CLASS OF NEYMAN-SCOTT MODELS FOR TEMPORAL RAINFALL,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W88-04109

RANDOM PROCESSES WITH LONG-RANGE DEPENDENCE AND HIGH VARIABILITY,
Boston Univ., MA. Dept. of Mathematics.
M. S. Taqqu.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. D8, p 9683-9686, August 1987. 18 ref. NSF Grant ECS-8696-090.

Descriptors: *Stochastic process, *Scaling, *Mathematical models, *Variability, *Meteorological data collection, Mathematical studies, Rainfall, Probabilistic process, Model studies.

A family of stochastic models which may be relevant to meteorology is described. The models are stochastic processes, denated temporarily by Z(t,x), where t is time, x is a position in space, and where Z measures a physical quantity of interest. These models can be characterized by the intensity of dependence, the heaviness of the probability tails, and the degree of nonlinearity. Two processes, the fractional stable motion and the spectral fractional stable motion, are introduced in some detail, and the range of values of their parameters is investigated. Both processes have scaling properties and display long-range dependence and high variability. (Author's abstract)
W88-04110

MESOSCALE ATMOSPHERIC DYNAMICS AND MODELING OF RAINFALL FIELDS,
Toronto Univ. (Ontario). Dept. of Physics.
H.-R. Cho, and D. S. T. Chan.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9687-9692, August 1987. 7 fig, 13 ref.

Descriptors: *Rainfall, *Model studies, *Air temperature, *Mathematical models, *Vortices, Hydrologic models, Weather patterns, Air masses, Simulation analysis, Precipitation, Stochastic process, Condensation, Weather.

A two-dimensional nonuniform potential vorticity model for frontogenesis was used to study the effects of mesoscale inhomogeneities on the vertical velocity field during the process of front formation. The effects of height-dependent mesoscale irregularities in potential temperature and potential vorticity fields during the early stages of a frontal development were examined. When height-dependent mesoscale irregularities are present in the potential temperature or the potential vorticity field, complex patterns in the vertical velocity field were induced which have considerable vertical extent. If the condensation of water vapor is included in the model, these deep mesoscale vertical velocity patterns will produce a complex mesoscale pattern of precipitation. These findings suggest that the evolution of the precipitation field in mid-latitude weather systems depends very much on the horizontal and vertical structures of the initial thermodynamic and dynamic fields at the mesoscale. The statistical properties of precipitation fields will depend not only on those of the initial mesoscale irregularities, but also on the nonlinear evolutionary properties of the dynamic system as a whole. (Geiger-PTT)
W88-04111

PHYSICAL MODELING AND ANALYSIS OF RAIN AND CLOUDS BY ANISOTROPIC SCALING MULTIPLICATIVE PROCESSES,
McGill Univ., Montreal (Quebec). Dept. of Physics.
For primary bibliographic entry see Field 2B.
W88-04112

EFFECTS OF SPATIAL VARIABILITY ON ANNUAL AVERAGE WATER BALANCE,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. C. D. Milly, and P. S. Eagleson.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2135-2143, November 1987. 6 fig, 4 tab, 21 ref. NSF ATM-7812327, ATM-8114723, and CEE-8307282.

Descriptors: *Spatial distribution, *Hydrologic budget, *Annual distribution, Soil water, Vegetation, Runoff, Evapotranspiration, Groundwater re-

charge, Soil water, Simulation analysis, Pore size, Permeability coefficient, Soil properties.

Spatial variability of soil and vegetation causes spatial variability of the water balance. For an area in which the water balance is not affected by lateral water flow, the frequency distributions of storm surface runoff, evapotranspiration, and drainage to groundwater are derivable from distributions of soil hydraulic parameters by means of a point water balance model and local application of the vegetal equilibrium hypothesis. Means and variances of the components of the budget can be found by Monte Carlo simulation or by approximate local expansions. For a fixed set of mean soil parameters, soil spatial variability may induce significant changes in the areal mean water balance, particularly if storm surface runoff occurs. Variability of the pore size distribution index and permeability has a much larger effect than that of effective porosity on the means and variances of water balance variables. The importance of the pore size distribution index implies that the microscopic similarity assumption may underestimate the effects of soil spatial variability. In general, the presence of soil variability reduces the sensitivity of water balance to mean properties. For small levels of soil variability, there exists a unique equivalent homogeneous soil type that reproduces the budget components and the mean soil moisture saturation of an inhomogeneous area. (Author's abstract)
W88-04191

VEGETATION CHARACTERISTICS AND THE PREDICTION OF RUNOFF: ANALYSIS OF AN EXPERIMENT IN THE NEW FOREST, HAMPSHIRE,
Southampton Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-04239

ESTIMATING THE WATER RESOURCE FOR A HIGH SIERRA WATERSHED,
New Jersey Hazardous Waste Facilities Siting Commission, Trenton.
For primary bibliographic entry see Field 6D.
W88-04276

CONTRIBUTIONS OF RAINFALL TO CONSTITUENT LOADS IN STORM RUNOFF FROM URBAN CATCHMENTS,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2B.
W88-04289

DIMENSIONLESS S-GRAPHS FOR URBAN WATERSHEDS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, and T. V. Hromadka.
Journal of Hydraulic Engineering JHENDS, Vol. 113, No. 7, p 907-911, July 1987. 3 fig, 1 tab.

Descriptors: *Urban watersheds, *Hydrograph analysis, *Rainfall-runoff relationships, *Data interpretation, Unit hydrographs, Hydrographs, Watersheds, Resources management.

In developing generalized unit hydrographs for regional design, the analysis often takes one of two paths. First, measured rainfall and runoff data are analyzed to develop T-hour unit hydrographs from which a generalized instantaneous unit hydrograph (IUH) can be computed using the S-graph approach. Second, where measured rainfall and runoff data are not available, time-area analysis can be made for watersheds. While peak discharge formulas were a primary hydrologic design tool in the past, unit hydrograph design storm methods are being used more frequently. The accuracy of designs based on such methods depends on the representativeness of the underlying unit hydrograph. When measured hyetographs and hydrographs are not available, accurate estimates of the shape of unit hydrographs for specific watersheds may be obtained from time-area analyses. It appears that dimensionless S-graphs obtained from time-area analyses are very accurate representations of S-graphs obtained from measured data and can be used to improve the accuracy of designs based on the unit hydrograph design storm approach. (Lantz-PTT)
W88-04391

HABITAT ELEMENTS IN RIVER BASIN MANAGEMENT AND PLANNING,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-04414

2B. Precipitation

MICROBIAL IMPLICATIONS OF DIEL VARIATIONS IN WATER QUALITY PARAMETERS POSSIBLY ASSOCIATED WITH ACID DEPOSITION IN AN OLIGOTROPHIC RESERVOIR,
New England Research, Inc., Worcester, MA.
For primary bibliographic entry see Field 5C.
W88-03615

WEATHER RADAR AND WEATHER RADAR PROCESSING SYSTEMS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 7B.
W88-03635

DISSOLVED OXYGEN: METHOD COMPARISON WITH POTENTIOMETRIC STRIPPING ANALYSIS,
Jordan Univ., Amman. Analytical Chemistry Labs.
M. Fayyad, M. Tutunji, R.S. Ramakrishna, and Z. Taha.
Analytical Letters ANALBP, Vol. 20, No. 4, p 529-535, June 1987. 2 tab, 6 ref.

Descriptors: *Analytical methods, *Water analysis, *Chemical analysis, *Natural waters, Dissolved oxygen, Potentiometric stripping analysis.

Methods for determination of dissolved oxygen in samples of natural water are compared. Although potentiometric stripping analysis and oxygen selective electrode methods are simple, rapid and of higher reproducibility than the usual Winkler procedure, the use of oxygen selective electrodes has quite a few disadvantages. Potentiometric stripping analysis, PSA compares well with oxygen selective electrodes. (Author's abstract)
W88-03637

STOCHASTIC REAL-TIME SPRING FLOOD FORECASTING SYSTEM FOR CARMAN, MANITOBA,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
D. M. Fay, W. E. Watt, and D. G. Watts.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 87-96, 1987. 10 fig, 5 tab, 9 ref.

Descriptors: Descriptors:*Flood forecasting, *Floods, *Manitoba, *Model studies, *Stochastic models, Forecasting, Transfer function noise modelling.

A stochastic system was developed for short-term spring flood forecasting for the Boyne River near Carman, Manitoba. The system comprises two models. The upstream model consists of a transfer function noise algorithm which forecasts 6-h mean streamflow up to 36h ahead for a site near Stephenfield, upstream of Carman. The inputs to this model are the recorded discharge of the Boyne near Stephenfield, temperature and precipitation during the melt period, cumulative winter precipitation, and an antecedent precipitation index for the previous summer and fall seasons. The downstream model is a transfer function noise model which uses previous discharges near Carman and recorded and forecast discharges near Stephenfield to forecast streamflow near Carman. Water-level forecasts near Carman are estimated from the forecast discharges with a stage discharge relation for the site. Seperate data sets were used to calibrate and verify the system. The system produced good forecasts for lead times up to 2 days. (Author's abstract)
W88-03643

CIRRUS-CLOUD EXPERIMENT: INTENSIVE FIELD OBSERVATIONS PLANNED FOR FIRE,
State Univ. of New York at Albany.
D. O. Starr.
Bulletin of the American Meteorological Society BAMIAT, Vol. 68, No. 2, p 119-124, February 1987. 3 fig, 1 tab, 13 ref.

Descriptors: Descriptors:*Clouds, *Weather, *Cloud cover, Field tests, Remote sensing, Cirrus clouds, Cirrus Intensive Field Observations, Wisconsin, Cloud lidars, Microphysical observations.

The Cirrus Intensive Field Observations (Cirrus IFO) is a major component for the First ISCCP Regional Experiment. The field campaign was conducted in Wisconsin during October 1986. Observing systems include satellites, 'cloud' lidars, a very high-altitude, satellite-simulater aircraft platform, two research aircraft instrumented for detailed in situ microphysical and radiometric observations, a Doppler lidar, numerous passive surface-radiation sites, and a rawinsonde network. This is the first cirrus experiment involving such a comprehensive observing system. (Author's abstract)
W88-03647

PLANT WATER POTENTIAL MEASURED CONTINUOUSLY IN THE FIELD,
National Vegetable Research Station, Wellsbourne (England).
For primary bibliographic entry see Field 2D.
W88-03660

WINTER STUDY OF AIR, CLOUD AND PRECIPITATION CHEMISTRY IN ONTARIO, CANADA,
Atmospheric Environment Service, Downsview (Ontario).
G. A. Isaac, and P. H. Daum.
Atmospheric Environment ATENBP, Vol. 21, No. 7, p 1587-1600, July 1987. 10 fig, 6 tab, 21 ref. DOE contract DE-AC02-76CH00016.

Descriptors: *Acid rain, *Chemistry of precipitation, *Path of pollutants, *Seasonal variation, *Air quality, *Water chemistry, *Clouds, *Ontario, *Rainfall, *Remote sensing, Monitoring, Air pollution, Nitrates, Cloud liquid water, Scavenging.

During January and February 1984, a field project was conducted near North Bay, Ontario, Canada. The principal objective was to characterize the chemical and microphysical properties of the air masses, clouds and precipitation in this region of NE North America during the winter season. Two extensively instrumented aircraft with some newly designed cloudwater and snow collectors were used, as well as a surface station continuously monitoring pollutant concentrations and a precipitation event sampling network. Pollutant concentrations at the surface were found to vary with the airmass back trajectory with the highest concentrations observed for trajectories from the S and SW and the lowest from the N. Vertical profiles of aerosol particle (0.2-2 micron diameter) and NOx concentrations show similar trends with maxima of 1200/cu cm and 7 ppb, respectively near ground level with air mass trajectories from the S, in comparison to values of 250/cu cm and 1 ppb obtained with trajectories from the N. Cloudwater, aircraft precipitation and ground precipitation samples had a daily median pH of 3.6, 4.6 and 4.2, respectively with the cloudwater having the highest sulfate and nitrate concentrations. The nitrate/sulfate equivalent concentration ratios in the cloudwater, aircraft precipitation and ground precipitation samples were 0.7, 0.6 and 1.4, respectively. The data suggest that precipitation scavenging of nitric acid below cloud base is an important process during the winter season. (Author's abstract)
W88-03779

BACKGROUND LEVELS OF AIR AND PRECIPITATION QUALITY IN EUROPE,
Institute for Atmospheric Physics, Budapest (Hungary).
D. J. Szepesi, and K. E. Fekete.
Atmospheric Environment ATENBP, Vol. 21, No. 7, p 1623-1630, July 1987. 3 fig, 1 tab, 29 ref.

Descriptors: *Air pollution, *Regional analysis, *Air quality, *Water quality, *Rainfall, *Europe, *Background levels, Sulfur, Nitrogen, Pollution sources.

This paper is intended to be used by specialists engaged in air and precipitation quality management on regional and continental scales. Major goals are to establish definition, methodology and specific values of background air and precipitation quality for sulfur (S) and nitrogen (N) species to be used in practical applications of air resources management. Major findings are the following: (a) 69% of SO2 and 63% of NO2 concentration over Europe originate from continental scale anthropogenic sources, (b) 15% of precipitation sulfate and 11% of precipitation nitrate over Europe are contributed by hemispheric background, (c) hemispheric background pollution values for Europe were found as 1.25 microgram(ug)(SO2-S)/cu m, 0.80 ug (SO4(2-)-S)/cu m, 0.157 mg (SO4(2-)-S)/L and 0.04 mg (NO3(-)-N)/L. (Author's abstract)
W88-03780

NUMERICAL SIMULATION OF OROGRAPHIC ENHANCEMENT OF RAIN WITH A MESOSCALE MODEL,
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
E. Richard, N. Chaumerliac, and J. F. Mahfouf.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 6, p 661-669, June 1987. 10 fig, 2 tab, 9 ref. CCVR (France) Project No. 3857, 3951.

Descriptors: *Orographic precipitation, *Model studies, *Rainfall, *Equations, Microphysics, Numerical simulation, Simulation, Case studies, Wales, Winds, Thermodynamics.

Orographic precipitation enhancement associated with the feeder-seeder mechanism proposed by Bergeron has been simulated using a two dimensional model based upon primitive equations including detailed parameterized microphysics. A case-by-case comparison is made between model results and each of 14 well-documented precipitation episodes in southern Wales. The model reproduces the observed strong dependence of the precipitation enhancement on the low-level wind speed, as well as the weak dependence on the upwind precipitation rate. Model results also demonstrate that a satisfactory treatment of orographically enhanced precipitation requires the linking of the dynamical, thermodynamical and microphysical processes. (Author's abstract)
W88-03807

PRECIPITATION DISCRIMINATION FROM SATELLITE INFRARED TEMPERATURES OVER THE CCOPE MESONET REGION,
Research and Data Systems, Inc., Lanham-Seabrook, MD.
M. Weiss, and E. A. Smith.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 26, No. 6, p 687-697, June 1987. 3 fig, 7 tab, 21 ref. NOAA Contract NA81AA-0-00058.

Descriptors: *Model studies, *Convective rainfall, *Rainfall, *Satellite technology, *Infrared technology, *Remote sensing, *Measuring instruments, Cloud temperature, CCOPE, Montana, Storms, Statistics, Temperature.

A quantitative investigation of the relationship between satellite-derived cloud-top temperature parameters and the detection of intense convective rainfall is described. The area of study is that of the Cooperative Convective Precipitation Experiment (CCOPE), which was held near Miles City, Montana during the summer of 1981. Cloud-top temperatures, derived from the GOES-West operational satellite, were used to calculate a variety of parameters for objectively quantifying the convective intensity of a storm. A dense network of raingages provided verification of surface rainfall. The cloud-top temperature field and surface rainfall data were processed into equally sized grid domains in order to best depict the individual samples of instantaneous precipitation. The technique of statistical discriminant analysis was used to determine which combinations of cloud-top temperature parameters best classify rain versus no-rain occurrence using three different rain-rate cutoffs: 1, 4, and 10 mm/h. Time lags within the 30 min rainfall verification were tested to determine the optimum time delay associated with rainfall reaching the ground. A total of six storm cases were used to develop and test the statistical models. Discrimination of rain events was found to be most accurate when using a 10 mm/h rain-rate cutoff. The parameters designated as coldest cloud-top temperature, the spatial mean of coldest cloud-top temperature, and change over time of mean coldest cloud-top temperature were found to be the best classifiers of rainfall in this study. Combining both a 10-min time lag (in terms of surface verification) with a 10 mm/h rain-rate threshold resulted in classifying over 60% of all rain and no-rain cases correctly. (Author's abstract)
W88-03808

HOW THE PACIFIC DRAINS THE NILE,
D. Mackenzie.
New Scientist NWSCAL, Vol. 114, No. 1555, p 16-17, April 16, 1987. 2 fig.

Descriptors: *Climatic data, *Africa, *Drought models, *Climatology, *Meteorological forecast, *El Nino, *Pacific Ocean, *Ocean temperature, Model studies, Weather patterns, Rainfall distribution .

Periodic drought conditions in Africa have been correlated to conditions in the Pacific Ocean. Studies show that the El Nino occurs every two to seven years, with an average of four years, in the south Pacific. This affects wind patterns in the Pacific which in turn affect weather conditions in countries around the Pacific. Scientists observed that the temperature of the central Pacific Ocean rises before the onset of El Nino. Climatologists have been trying to find a single variable in world weather that seems reliably to precede the longer periods of low rainfall in Africa. They think that this single variable is the temperature difference in the southern and northern hemispheres. Thus, data on ocean temperatures may form the basis for predictive models for movements of the intertropical convergence zone and give a six-month warning of the onset of intense short-term drought in both east and west Africa. (Ray-PTT)
W88-03842

INTERIM PROGRESS REPORT SCPP FORECASTING SUPPORT: FOR PERIOD 1 SEPTEMBER 1983-31 AUGUST 1984, VOLUME II,
Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 3B.
W88-03948

COMPARISONS OF GAUGE AND SATELLITE RAIN ESTIMATES FOR THE CENTRAL UNITED STATES DURING AUGUST 1979,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
C. G. Griffith.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9551-9566, August 1987. 14 fig, 9 tab, 36 ref.

Descriptors: *Data collections, *Rain gages, *Weather forecasting, *Satellite technology, *Rainfall, *Algorithms, *Meteorological data collection, Error analysis, Networks, Weather data collections, Rainfall rate, Infrared imagery, Data interpretation.

Rainfall estimates, inferred from the thermal infrared channel of the Geostationary Operation Environmental Satellite - East (GOES - East) for August 1979, are compared with gage rainfalls over hourly and daily time frames for area-averaged amounts and point values. The area of interest is a 3,600,000 sq km region in the central third of the United States. Over the month the satellite rainfalls tend to be smaller by 20-40% than the corresponding gage amounts, but mean sampling errors inherent in a gage network of this density (1 gage/4000 sq km) are estimated to be minimally 100% of the areal mean rainfall. Root-mean-square errors are approximately 1 mm for daily and 0.1 mm for hourly area-averaged rainfalls and are 14 mm for daily and 5 mm for hourly point rainfalls. Satellite-gage differences of daily (hourly) point values can be large, but 50% of the satellite amounts are within + or - 4(+ or - 2) mm of the gage amount, and 90% are within + or - 20(+ or - 8) mm, reinforcing the fact that the satellite-derived rainfall is an area-averaged rather than a point estimate of rain amount. Timing of rain events is comparable for daily area-averaged satellite and gage data. However, hourly area-averaged gage data exhibit considerably more short-term fluctuations than the hourly satellite data. For the two satellite algorithms tested, the streamlined technique requires the least computation time (10% of that needed by the life history technique) and shows little difference in its comparisons with the gages. (Author's abstract)
W88-04098

SAMPLING ERRORS IN SATELLITE ESTIMATES OF TROPICAL RAIN,
Pixel Analaysis, Silver Spring, MD.
A. McConnell, and G. R. North.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9567-9570, August 1987. 2 fig, 2 tab, 4 ref.

Descriptors: *Satellite technology, *Remote sensing, *Rainfall rate, *Tropical regions, *Error analysis, *Sampling, Data interpretation, Mathematical studies, Aerial photography, Meteorological data collection, Weather data collections, Markov process, Models, Rainfall distribution, Statistical analysis.

Sampling errors that might be expected when using a low earth-orbiting satellite are statistically analyzed using the GATE (Global Atmospheric Research Program Atlantic Tropical Experiment) rainfall data set. For averages over the entire 400-km square, and for the duration of several weeks, sampling errors of $<10\%$ can be expected in contributions from each of four rain rate categories (light, medium, heavy, and very heavy) which individually account for about one quarter of the total rain. Two types of errors are identified that could invalidate the theory that errors of the order of 5-10% are achievable by twice-a-day snapshots in estimating monthly averages of total rain over the 500-km grid boxes: (1) GATE consisted of only two segments, and not enough sampling is being performed to get good estimates of the sampling errors; and (2) the GATE area might not be representative of other areas of the tropics. This second possibility cannot be determined without collecting more data through carefully planned experiments. (Geiger-PTT)
W88-04099

COKRIGING RADAR-RAINFALL AND RAIN GAGE DATA,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
W. F. Krajewski.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9571-9580, August 1987. 8 fig, 32 ref.

Descriptors: *Rainfall rate, *Radar, *Rain gages, *Data interpretation, *Statistical analysis, Mathematical studies, Weather data collections, Algorithms, Sensitivity analysis, Mathematical models, Simulation analysis, Kriging.

An ordinary cokriging procedure has been developed to optimally merge rainfall data from radars and standard rain gages. The radar-rainfall data are given in digitized form. The covariance matrices required to perform cokriging are computed from

single realization data, using the ergodicity assumption. Since the ground truth and the error structure of the radar data are unknown, parameterization of the covariance between radar data and the true rainfall is required. The sensitivity of the procedure to that parameterization is analyzed within a controlled simulation experiment. The experiment is based on a hypothesized error structure for the rainfall measurements. The effect of measurement noise and network density is examined. The usefulness of the procedure to remove the bias in radar is tested. Preliminary results of the specification of the values of the parameters beta sub R (for various rain gage densities), show that the range of 0.2-0.4 for both parameters. The robutness of these results needs to be further investigated. Also, for data collected at other than daily intervals (hourly, 6-hourly, etc.), these results may not be valid. It is expected that the performance of the presented method, relative to rain gage data analysis, should be better for hourly data. (Geiger-PTT)
W88-04100

FRACTAL STRUCTURE AND EXPONENTIAL DECORRELATION IN RAIN,
Quebec Univ., Montreal.
I. Zawadzki.
Journal of Geophysical Research (D) JGRDE3 Vol. 92, No. 8, p 9586-9590, August 1987. 4 fig, 11 ref.

Descriptors: *Rain gages, *Statistical analysis, *Scaling, *Sampling, *Rainfall rate, Simulation analysis, Mathematical models, Correlation analysis, Error analysis, Radar.

Statistics of rain rate increments from a 10-year record of a tipping bucket rain gage were analyzed for various effects: smoothing of data, sampling of data, noise in the data, and their consequences on the evidence for the fractal structure of rain. Results showed that rain becomes effectively decorrelated after approximately 20 min. No evidence for scaling of rain rate increments in time is apparent from this analysis. (Author's abstract)
W88-04102

MESOSCALE CONVECTIVE COMPLEXES IN THE AMERICAS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
I. Velasco, and J. M. Fritsch.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9591-9613, August 1987. 19 fig, 3 tab, 60 ref. Office of Naval Research Grant SFRC N00014-86-K-0688 and National Science Foundation Grants ATM-82 18208 and ATM-84 18995.

Descriptors: *South America, Satellite technology, *Infrared imagery, *Meteorologic data collection, *Convection, Rainfall, Weather data collections, Tropical regions, Tropical cyclones, Air circulation, Tropic zone, Flooding, Convective precipitation, Data interpretation, Precipitation.

Enhanced infrared satellite imagery and conventional surface and sounding data are used to document the existence and climatological characteristics of mesoscale convective complexes (MCCs) over mid-latitude South America and in the tropical region between North and South America. It was found that MCCs occur with approximately the same frequency in mid-latitude South America as they do in mid-latitude North America. For the most part, the characteristics of mid-latitude South American MCCs are similar to those of MCCs in the United States. The most notable difference between North and South American MCCs is that the South American systems are, on the average, about 60% larger than MCCs in the United States. In addition to the large population of mid-latitude South American MCCs, an even larger number of low-latitude (tropical) systems were found. In general, both the mid-latitude and tropical populations of MCCs are nocturnal and continental; i.e., the great majority of systems occur at night over land. Of the systems that do occur over water, a significant fraction develop into tropical storms. Large populations of MCCs occur in each of the physiographically similar mid-latitude areas of North and South America where low-level nocturnal jets frequently develop. Very few MCCs occur over the Amazon River Basin or over the southeastern United States, even though both of these areas exhibit large amounts of deep convective activity. All of the various MCC population centers occur in latitudinal zones of westerlies or easterlies and are concentrated immediately downwind of major mountain ranges. During an El Nino period the number of mid-latitude South American systems was more than double the number in the non-El Nino year. Several MCCs formed over the anomalously warm water that appeared along the Peruvian coast. Thus on the basis of this very small sample, there may be a direct connection between MCC activity and El Nino. (Author's abstract)
W88-04103

SPACE-TIME STOCHASTIC MODEL OF RAINFALL FOR SATELLITE REMOTE-SENSING STUDIES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
T. L. Bell.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9631-9643, August 1987. 9 fig, 30 ref, append.

Descriptors: *Distribution patterns, *Rainfall, *Stochastic process, *Satellite technology, *Remote sensing, *Data interpretation, Model studies, Temporal distribtuion, Spatial distribtuion, Algorithms, Tropical regions, Mathematical studies, Statistical analysis.

A model of the spatial and temporal distribution of rainfall produces random spatial rainfall patterns with these characteristics: (1) The model is defined on a grid with each grid point representing the average rain rate over the surrounding grid box; (2) Rain occurs at any one grid point (on average, a specified percentage of the time and has a lognormal probability distribution); (3) Spatial correlation of the rainfall can be arbitrarily prescribed. (4) Time stepping is carried out so that large-scale features persist longer than small-scale features. Rain is generated in the model from the portion of a correlated Gaussian random field that exceeds a threshold. The portion of the field above the threshold is rescaled to have a lognormal probability distribution. Sample output is given for the model designed to mimic radar observations of rainfall during the Global Atmospheric Research Program Atlantic Tropical Experiment (GATE). The model is intended for use in evaluating sampling strategies for satellite remote-sensing of rainfall and for development of algorithms for converting radiant intensity received by an instrument from its field of view into rainfall amount. (Author's abstract)
W88-04105

RECTANGULAR PULSES POINT PROCESS MODELS FOR RAINFALL: ANALYSIS OF EMPIRICAL DATA,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, B. Febres de Power, and J. B. Valdes.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9645-9656, August 1987. 9 fig, 15 tab, 7 ref.

Descriptors: *Rainfall intensity, *Model studies, *Statistical methods, *Denver, Hydrologic models, Temporal distribution, Poisson ration, Mathematical models, Mathematical studies, Colorado.

Some rainfall data from Denver, Colorado, were analyzed in detail at different levels of aggregation which ranging from 1 to 24 hours. Two classes of models were then fitted to the data. In the first class of models, storm events arise in a Poisson process, each such event being associated with a period of rainfall of random duration and constant but random intensity. Total rainfall intensity is formed by adding the contributions from all storm events. In the second class of models, storms arise in a Poisson process, each storm giving rise to a cluster of rain cells in which each cell has a random duration and constant but random intensity. The estimation of the model parameters is performed through the first and second-order moments of the cumulative rainfall process at different levels of aggregation. The first class of models gives a poor fit at levels of aggregation different from the one at which the model parameters are estimated. Cluster-based models are able to take account of the cumulative rainfall characteristics over a range of time scales from 12 to 24 hours without changing the model parameters. These models also perform well in regard to the extreme values of rainfall for different periods of aggregation and the time concentration of total rainfall. (Author's abstract)
W88-04106

TAYLOR'S HYPOTHESIS AND DISSIPATION IN RAINFALL,
Mississippi Univ., University. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04107

APPLICATION OF SPATIAL POISSON MODELS TO AIR MASS THUNDERSTORM RAINFALL,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson, N. M. Fennessey, W. Qinliang, and I. Rodriguez-Iturbe.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. D8, p 9661-9678, August 1987. 22 fig, 3 tab, 19 ref. NASA Grant NAG5-388, and NSF Grant ATM-8420781.

Descriptors: *Rainfall distribution, *Spatial distribution, *Model studies, *Poisson ratio, *Rain gages, Thunderstorms, Statistical analysis, Rainfall, Hydrologic models, Mathematical studies.

Eight years of summer storm rainfall observations from 93 stations in and around the 154 sq km Walnut Gulch catchment of the Agricultural Research Service, U. S. Department of Agriculture, in Arizona were processed to yield the total station depths of 428 storms. Statistical analysis of these random fields yielded the first two moments, the spatial correlation and variance functions, and the spatial distribution of total rainfall for each storm. The sample was then split, and half was used to estimate, for each storm day, the distributions of the three parameters of each of the three conceptual spatial Poisson process models proposed previously. The absolute and relative worth of the three Poisson models were evaluated by comparing their prediction of the spatial distribution of storm rainfall with observations from the second half of the sample. These point process models appear capable of reproducing important features of the spatial distribution of total storm precipitation. On the basis of the comparative evaluation, one of the models may be discarded because it is quite cumbersome analytically. Of the two remaining models, the one that is preferred indicates a density of convective 'cells' within these air mass thunderstorms of about 1 cells/50 sq km, having an average center of depth of 14 mm and a radius (at 1% of center) of 6 km. These dimensions compare favorably with those published previously for thunderstorms in the southeastern coastal plains of the U.S. (Geiger-PTT)
W88-04108

ASSESSMENT OF A CLASS OF NEYMAN-SCOTT MODELS FOR TEMPORAL RAINFALL,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and P. Guttorp.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9679-9682, August 1987. 2 tab, 21 ref.

Descriptors: *Mathematical models, *Temporal distribution, *Model studies, *Rainfall distribution, *Acid rain, Stochastic process, Path of pollutants, Mathematical studies, Simulation analysis, Sensitivity analysis, Poisson ratio, Rainfall.

Neyman-Scott type cluster point processes have been used in several studies to model temporal rainfall at a single location. The time scale consistency of parameter estimates for such models, with the rainfall thought of as instantaneous bursts at the points of the Neyman-Scott process, was examined. Problems in applying the Neyman-Scott models to the maximum likelihood estimation and the method of moments are described. The sensivity of the Neyman-Scott models to choice of cluster size distribution is examined using data from the MAP3S (Multistate Atmospheric Power Product Pollution Study) acid rain monitoring network. (Geiger-PTT)
W88-04109

RANDOM PROCESSES WITH LONG-RANGE DEPENDENCE AND HIGH VARIABILITY,
Boston Univ., MA. Dept. of Mathematics.
For primary bibliographic entry see Field 2A.
W88-04110

MESOSCALE ATMOSPHERIC DYNAMICS AND MODELING OF RAINFALL FIELDS,
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2A.
W88-04111

PHYSICAL MODELING AND ANALYSIS OF RAIN AND CLOUDS BY ANISOTROPIC SCALING MULTIPLICATIVE PROCESSES,
McGill Univ., Montreal (Quebec). Dept. of Physics.
D. Schertzer, and S. Lovejoy.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9693-9714, August 1987. 11 fig, 65 ref, 4 append.

Descriptors: *Scaling, *Radar, *Rain, *Clouds, *Stochastic process, Model studies, Mathematical models, Statistical methods, Mathematical studies, Theoretical analysis, Numerical analysis.

The basic properties of rain and cloud fields (particularly their scaling and intermittency) are best understood in terms of coupled (anisotropic and scaling) cascade processes. Such cascades provide a framework not only for theoretically and empirically investigating these fields, but also for constructing physically based stochastic models. This physical basis is provided by cascade scaling and intermittency, which is of broadly the same sort as that specified by the dynamical (nonlinear, partial differential) equations. Theoretically, the links between the divergence of high-order statistical moments, the multiple scaling and dimensions of the fields, and the multiplicative and anisotropic nature of the cascade processes themselves are clarified. Such fields can be modeled by fractional integration of the product of appropriate powers of conserved but highly intermittent fluxes. These ideas are empirically tested by exploiting high-resolution radar rain reflectivities. The divergence of moments is established by direct use of probability distributions, whereas the multiple scaling and dimensions required the development of new empirical techniques. The first of these estimates the trace moments of rain reflectivities, which are used to determine a moment-dependent exponent governing the variation of the various statistical moments with scale. This exponent function in turn is used to estimate the dimension function of the moments. A second technique, functional box counting, is a generalization of a method first developed for investigating strange sets and permits the direct evaluation of another dimension fucntion associated with the increasingly intense regions. The different intensities are related to singularities of different orders in the field. This technique provides the basis for another new technique, elliptical dimensional sampling, which permits the elliptical dimension rain (describing its stratification) to be directly estimated. (Author's abstract)
W88-04112

ELECTROSTATIC ENERGY OF A THUNDERSTORM AND ITS RATE OF CHANGE,
National Center for Atmospheric Research, Boulder, CO.
A. J. Weinheimer.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9715-9722, August 1987. 1 fig, 29 ref, 2 append.

Descriptors: *Thunderstorms, *Lightning, *Energy, *Mathematical models, Theoretical analysis, Mathematical studies, Convection, Convective precipitation, Model studies.

The method most commonly used to assess the contribution of a single, charged precipitation particle to the rate of change of electrostatic energy of a thunderstorm is problematic. Equating the rate to the product of the net electrical force and a velocity leads to an arbitrary value of the contribution of a single particle. In the present analysis, this arbitrariness is removed by viewing the contribution of a single particle as being due to its motions with respect to all the other individual charges. It is also shown that in spite of this arbitrariness of the usual method when applied to individual particles, it nonetheless yields a nonarbitrary value for the total rate of change of electrostatic energy for the whole collection of charges. In the event that differences in sedimentation velocity are not adequate to account for the electrification of thunderstorms, this does not imply that all precipitation-based mechanisms are ineffective, as is sometimes suggested. The possibility yet remains that convective processes may be effective in driving the large-scale separation of precipitation particles from other charged particles. (Author's abstract)
W88-04113

GASEOUS DEPOSITION TO SNOW. I. EXPERIMENTAL STUDY OF SO2 AND NO2 DEPOSITION,
Arizona Univ., Tucson. Dept. of Atmospheric Sciences.
M. P. Valdez, R. C. Bales, D. A. Stanley, and G. A. Dawson.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9779-9787, August 1987. 5 fig, 1 tab, 32 ref. U. S. Forest Service Contract 28-G5-345.

Descriptors: *Snow, *Sulfur compounds, *Acid precipitation, *Nitrogen compounds, *Deposition, *Path of pollutants, Temperature effects, Ions, Oxides, Chemistry of precipitation, Ozone, Snowpack, Adsorption, Light intensity.

A series of 48 laboratory experiments has determined depth profiles of S(IV) and S(VI) accumulation in snow exposed to 20-140 ppb SO2 for 6-12 hours. Surface deposition velocity, calculated from the amount of sulfur taken up, divided by the gas-phase concentration, averaged 0.06 cm/sec. Snow held near -2 degrees had an average deposition velocity of 0.04 cm/sec, with new snow having a value about double that for older, metamorphosed snow (0.5 versus 0.02 cm/sec). Snow held near 0 degrees had an average deposition velocity of 0.07 cm/sec, and snow held below zero, but with surface melting due to sunlight, had a value of 0.06 cm/sec. When sunlight and temperature allowed draining of meltwater, deposition velocities were much higher (0.14 cm/sec). Deposition velocities for snow at -2 degrees were as much as 60% higher for measurements over 6 hours versus 10-12 hours. Penetration of sulfur into the snow was generally about 7 cm for colder experiments and only 4 cm for snow with more liquid water present. Uptake of SO2 by snow is apparently determined largely by the liquid-water-to-air ratio in the snowpack. SO2 and ozone concentrations had only small effects on deposition velocity. Most sulfur in the snow was found as S(VI), even in the absence of ozone, indicating that another oxidant is readily available, especially in new snow. Sunlight had no effect on uptake, other than increasing the liquid-water-to-air ratio by surface melting of the snow. Four measurements of NO2 deposition to snow were also made; uptake was small, with deposition velocities averaging 0.005 cm/sec in the dark and 0.012 cm/sec in the sunlight. (See also W88-04115) (Author's abstract)
W88-04114

GASEOUS DEPOSITION TO SNOW. II. PHYSICAL-CHEMICAL MODEL FOR SO2 DEPOSITION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. C. Bales, M. P. Valdez, and G. A. Dawson.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9789-9799, August 1987. 12 fig, 3 tab, 30 ref. NSF Grant ATM-82 15694 and U. S. Forest Service Contract 28-95-345.

Descriptors: *Sulfur compounds, *Acid precipitation, *Snowpack, *Deposition, *Mathematical models, *Accumulation, *Path of pollutants, Snow, Chemistry of precipitation, Model studies, Acidic water, Adsorption, Ozone.

A diffusion/reaction model of SO2 uptake by snow containing liquid water is used to examine the snowpack processes controlling accumulation of dissolved S(IV) and S(VI). Surface deposition velocity (defined as overall accumulation rate divided by surface SO2 concentration) depends on the amount of liquid water in the snow, the time scale considered, the rate of S(IV) to S(VI) conversion in the aqueous phase, and the SO2 concentration. In the absence of any oxidation, the deposition velocity for dense snow (specific gravity 0.4) with a moderate liquid water mass fraction and SO2 concentration of 20 ppbv (parts per billion by volume) is calculated to be 0.026 cm/sec after 6 hours. Deposition velocity increases by a factor of 3.2 for each tenfold increase in liquid water mass fraction and by a factor of 2.5-3.2 for each tenfold decrease in time. SO2 penetration into the snowpack is about 5 cm for the 6-hour case. In the presence of air containing 30 ppbv ozone and otherwise identical conditions, 80% of the accumulated sulfur is as S(VI), and the calculated deposition is 0.036 cm/sec. A further tenfold increase in ozone concentration gives only a 70% increase in deposition velocity. A similar dependence is calculated for oxygen (catalyzed by Fe(III)) as oxidant, but that for hydrogen peroxide is much stronger and almost linear. A tenfold increase in SO2 concentration (with ozone at 30 ppb) results in a 2.3-fold decrease in deposition velocity. Wet snow with a liquid water mass fraction of about 0.1 gives a deposition velocity at 20 ppb SO2 of 0.12 cm/sec, with a penetration of only 2 cm. Calculated and observed uptakes of SO2 by snow are in good agreement. (See also W88-04114) (Author's abstract)
W88-04115

AEROSOL AND GRAPHITIC CARBON CONTENT OF SNOW,
New Mexico State Univ., Las Cruces. Dept. of Physics.
P. Chylek, V. Srivastava, L. Cahenzli, R. G. Pinnick, and R. L. Dod.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9801-9809, August 1987. 8 fig, 8 tab, 19 ref.

Descriptors: *Carbon, *New Mexico, *Texas, *Antarctica, *Greenland, *Path of pollutants, *Air pollution, Aerosols, Snow, Chemistry of precipitation, Core logging, Ice, Snowmelt, Infrared spectroscopy, Organic carbon, Lasers, Chemical analysis.

Snow samples from southern New Mexico, west Texas, Antarctica, and Greenland were analyzed for aerosol and graphitic carbon. Snowmelt water from the snow samples was filtered through quartz and PVC membranes before analysis by infrared transmission spectroscopy for aerosol content, or laser beam analysis for graphitic carbon. Graphitic carbon contents were between 2.2 and 25 micrograms/liter of snow meltwater. Water-insoluble aerosol content varied between 0.62 and 8.5 micrograms/liter. Two samples of Camp Century, Greenland ice cores (approximate ages of 4,000 and 6,000 years) were analyzed to assess recent anthropogenic effects on graphitic carbon deposition. Ice core graphitic carbon contents were 2.5 and 1.1 micrograms/liter, suggesting that there has been no significant increase in graphitic carbon deposition in Greenland due to anthropogenic activity. However, in New Mexico and Texas, rural

aerosol graphitic carbon contents of around 5 micrograms/liter and urban aerosol graphitic carbon contents of up to 16 micrograms/liter reflect local anthropogenic sources of graphitic carbon. (Geiger-PTT)
W88-04116

RATE CONSTANTS FOR SOME OXIDATIONS OF S(IV) BY RADICALS IN AQUEOUS SOLUTIONS,
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
For primary bibliographic entry see Field 2K.
W88-04136

AUTOMATIC RAIN GAUGE FOR CONTINUOUS, REAL TIME DETERMINATION OF RAINWATER CHEMISTRY,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 7B.
W88-04141

ACCURACY OF AREAL RAINFALL ESTIMATION: A CASE STUDY,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
T. Lebel, G. Bastin, C. Obled, and J. D. Creutin.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2123-2134, November 1987. 8 fig, 7 tab, 19 ref, append.

Descriptors: *Rainfall, *Case studies, *Net rainfall, *Data interpretation, *Estimating equations, Mathematical studies, Climatology, Mathematical analysis.

Good estimates of mean areal rainfall are needed as inputs to hydrologic models. When based on ground measurements, their accuracy depends on the spatial variability of the rainfall process and on the rain gage network density. Accuracy is of particular importance when areal rainfall estimates must be computed in real time as inputs to runoff forecasting models. The high cost of equipping and maintaining the required telemetering facilities, especially in mountainous regions, often results in low-density observation networks. The accuracy of areal rainfall estimation was validated through a case study on a catchment area in the Cevennes region of France. The basic tool for the analysis was a 'scaled estimation error variance' which was computed from a scaled climatological variogram model of the rainfall field. The use of this variance to provide a theoretical criterion to compare the accuracy that can be expected with three linear estimators (Thiessen, spline, and kriging) for various networks' densities is illustrated. To support the methodology, an experimental validation of the scaled estimation error variance computation was performed, using 'reference' areal rainfall values computed with a very high density network. (Lantz-PTT)
W88-04190

400 YEARS OF CENTRAL CALIFORNIA PRECIPITATION VARIABILITY RECONSTRUCTED FROM TREE-RINGS,
California Univ., Santa Barbara. Dept. of Geography.
J. Michaelsen, L. Haston, and F. W. Davis.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 809-818, October 1987. 5 fig, 6 tab, 24 ref. California Water Resources Center Grant W-657.

Descriptors: *Paleoclimatology, *Precipitation variability, *Precipitation, *Data acquisition, *Hydrologic aspects, *Tree rings, Trees, Data interpretation, Central California, Spruce trees, Rainfall, Calibrations, Hydrologic data.

Coastal central California is a region that has never been the subject of tree-ring studies. New tree-ring chronologies developed from cores of big cone spruce (Pseudotsuga macrocarpa (Torr.) Mayr.) growing in the Transverse Ranges of central Santa Barbara county were used to reconstruct precipitation fluctuations for this region. To verify the new reconstructions, calibration with recorded rainfall using cross-validation, comparison with other reconstructions, and documentary evidence from historical sources were utilized. The precipitation reconstructions show that there were no fluctuations in mean precipitations on time scales longer than 30 years, but there were major fluctuations in precipitation variability including changes in the frequency of extremes and rare events that have not occurred in the modern record. (Author's abstract)
W88-04281

USE OF RADAR TO DERIVE A STORM INTENSITY-DURATION CURVE,
Alberta Research Council, Edmonton. Resource Technologies Dept.
For primary bibliographic entry see Field 7B.
W88-04286

CONTRIBUTIONS OF RAINFALL TO CONSTITUENT LOADS IN STORM RUNOFF FROM URBAN CATCHMENTS,
Geological Survey, Tacoma, WA. Water Resources Div.
J. C. Ebbert, and R. J. Wagner.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 867-871, October 1987. 1 fig, 2 tab, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Urban runoff, *Nitrogen compounds, *Water pollution sources, Rainfall, Water quality, Suspended solids, Catchment areas, Nitrates, Lead, Mathematical studies.

Rainfall is a significant source of some constituents, particularly nitrogen species, in storm runoff from urban catchments. Median contributions of rainfall to storm runoff loads of 12 constituents from 31 urban catchments, representing eight geographic locations within the United States, ranged from 2% for suspended solids to 74% for total nitrite plus nitrate nitrogen. The median contribution of total nitrogen in rainfall to runoff loads was 41%. Median contributions of total-recoverable lead in rainfall to runoff loads varied by as much as an order of magnitude between catchments in the same geographic location. This indicates that average estimates of rainfall contributions to constituent loading in storm runoff may not be suitable in studies requiring accurate constituent mass-balance computations. (Author's abstract)
W88-04289

ARE RAIN RATE PROCESSES SELF-SIMILAR,
Maryland Univ., College Park. Dept. of Mathematics.
B. Kedem, and L. S. Chiu.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1816-1818, October 1987. 1 fig, 1 tab, 4 ref. NASA Contract NAS5-30083.

Descriptors: *Rainfall rate, *Mathematical studies, *Self-similarity, Mathematical equations, Mathematical models, Model studies, Precipitation, Rainfall area, Rainfall, Probabilistic process.

The implication of the facts that the probability of rain tends to increase with the size of the area of observation and that the distribution of rain rate contains an atom at zero are clarified with respect to self-similarity. These properties observed in precipitation processes lead to subtle difficulties which are not compatible with self-similarity. Mathematical equations are presented which show that under very reasonable conditions, rain rate processes without any external operations such as limiting operations cannot be self-similar. (Wood-PTT)
W88-04301

PARAMETER ESTIMATION OF TEMPORAL RAINFALL MODELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. T. B. Obeysekera, G. Q. Tabios, and J. D. Salas.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1837-1850, October 1987. 15 fig, 5 tab, 16 ref. NSF Grants ECS-8515138 and ECS-8515141.

Descriptors: *Rainfall, *Temporal distribution, *Parameter estimation, *Model studies, *Data interpretation, Precipitation, Mathematical models, Mathematical equations, Mathematical studies, Colorado, Correlation analysis, Seasonal variation.

Characteristics and moment estimators of temporal rainfall models such as Poisson rectangular pulse (PRP), Neyman-Scott white noise (NSWN), and Neyman-Scott rectangular pulse (NSRP) are investigated. It is shown that PRP and NSWN have a correlation structure like that of an autoregressive moving average (ARMA)(1,1) model whereas the NSRP has a dependence structure like that of an ARMA (2,2). The admissible regions of lag-1 and lag-2 autocorrelations are derived to demonstrate that in general they are more restricted than their ARMA counterparts. An additional property denoted as variance ratio, which is intimately related to the scale of fluctuation of a process, is defined and used for model comparison. The bias and mean square error properties of the moment estimators are investigated with emphasis on the NSWN model, for which it is suggested that the temporal scale T, defined by BetaT = 1, provides the most efficient estimators of the parameters. Parameter Beta defines the arrival of rain bursts relative to the origin of storm systems. All three models are fitted to an extensive data set covering hourly precipitation data at 38 stations in northeastern Colorado. The correlation and variance ratio plots are used to select the appropriate model for each month. However, it is shown that the diurnal periodicity of storm occurrence is predominant during summer months, which is a characteristic not built into any of the considered temporal models. (Author's abstract)
W88-04305

STATISTICAL MODELING OF SPACE-TIME RAINFALL USING RADAR AND RAIN GAGE OBSERVATIONS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and W. F. Krajewski.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1893-1900, October 1987. 1 fig, 2 tab, 25 ref, append.

Descriptors: *Rainfall, *Statistical models, *Space-time rainfall, *Rain gages, *Radar, *Data interpretation, Model studies, Mathematical equations, Remote sensing, Estimating, Mathematical studies, Weather, Gages, Sampling, Atlantic region.

A statistical framework for modeling space-time rainfall using radar and rain gage observations is developed. Three principal tasks are involved in implementing the statistical model. These tasks are referred to as sampling (that is, characterization of the error structure of radar and rain gage measurements of rainfall), modeling (that is, specification of a stochastic model for space-time rainfall), and parameter estimation. It is emphasized that sampling, modeling, and parameter estimation are interrelated and equally important tasks. The statistical model is applied to daily rainfall fields in the tropical Atlantic region covered by the GATE experiment. Results from this application suggest that the rainfall model is suitable for many of the important components of tropical Atlantic rainfall, it is not capable of representing the low-intensity components of the rainfall process. (Wood-PTT)
W88-04310

2C. Snow, Ice, and Frost

USE OF SNOW-PILLOW DATA FOR MELT RATE INPUT TO THE STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION WATERSHED MODEL,
Alberta Environment, Edmonton.
For primary bibliographic entry see Field 2E.
W88-03644

THERMALLY INDUCED HEAVE BENEATH CHILLED PIPELINES IN FROZEN GROUND,
Hardy Associates, Calgary (Alberta).
J. F. Nixon.

Canadian Geotechnical Journal CGLOAH, Vol. 24, No. 2, p 260-266, May 1987. 9 fig, 18 ref.

Descriptors: *Frost heaving, *Model studies, *Pipelines, *Frozen ground, Steady state, Hydraulic conductivity, Permeability coefficient, Seasonal variation, Equations, Prediction.

Thermally induced water migration beneath chilled structures in frozen ground near its melting point has been considered by some as a possible source of heave and structural distress. The two-dimensional problem of thermally induced water flow in frozen soils beneath a chilled buried pipe, both for steady state and early transient conditions is analyzed. The analysis has identified the primary variables of interest in the problem of thermally induced heave in frozen ground, and by omitting some second-order effects has obtained a relatively straightforward relationship for the steady state heave rate due to this process. Using published relationships for hydraulic conductivity of frozen soils, it is concluded that heave induced by this mechanism will be relatively minor, and should not result in significant pipe bending or structural distress in the long term. Initial transient and seasonal effects were studied using the same governing equation for fluid flow, coupled with the author's two-dimensional thermal simulator. Additional heave due to these effects does not appear to increase the overall predicted heave greatly. (Author's abstract)
W88-03756

ICE VOLUMES ON CASCADE VOLCANOES: MOUNT RAINER, MOUNT HOOD, THREE SISTERS, MOUNT SHASTA,
Geological Survey, Tacoma, WA. Water Resources Div.
C. L. Driedger, and P. M. Kennard.
Available from Supt Doc, USGPO, Wash, DC 20402. USGS Professional Paper 1365, 1986. 28 p, 27 fig, 6 tab, 28 ref.

Descriptors: *Ice thickness, *Snowpack, *Glaciers, *Volcanoes, *Remote sensing, *Radar, Hazards, Volumetric analysis, Mount Rainier, Mount Hood, Three Sisters, Mount Shasta, Ice radar, Washington, Oregon, California.

A monopulse-radar unit contained in a backpack was used to make point measurements of ice thickness on major glaciers of Mount Rainier, Washington; Mount Hood, Oregon, The Three Sisters, Oregon; and Mount Shasta, California. Glacier volumes were calculated from the resulting basal maps. The maps were used to develop volume estimation methods for use on unmeasured glaciers. These methods require a knowledge of glacier slopes, altitude and area, and an estimation of basal shear stress, with each derived from topographic maps updated by aerial photos. The estimation methods may be applicable to other glaciers in similar climatic settings. The volumes of ice and snow in billions of cu ft on the four Cascade volcanoes are as follows: Mount Rainier, 155.8; Mount Hood, 12.2; Three Sisters, 5.6; and Mount Shasta, 4.7. (USGS)
W88-03894

OBSERVATIONS OF THE PREFERENTIAL LOSS OF MAJOR IONS FROM MELTING SNOW AND LABORATORY ICE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W88-04032

RADIOACTIVE CESIUM FROM THE CHERNOBYL ACCIDENT IN THE GREENLAND ICE SHEET,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04094

HUBBARD GLACIER IS STILL ON THE MOVE,
Geological Survey, Anchorage, AK.
P. A. Emery, and H. R. Seitz.
Geotimes GEOTAJ, Vol. 32, No. 5, p 8-9, May 1987. 3 fig.

Descriptors: *Glacier surges, *Glaciers, *Hubbard Glacier, Alaska, St. Elias Mountains, Glaciohydrology, Lakes, Lake formation, Glacial lakes, Glaciology.

In late May, Hubbard Glacier, one of Alaska's largest tidewater glaciers surged into Disenchantment Bay and blocked Russell Fjord changing the fjord into a temporary lake. Runoff from a 700 square mile drainage area began to fill the lake, inundating alluvial fans, outwash plains, and forests bordering the new lake. The lake level was monitored daily and Hubbard Glacier and its tributaries were watched carefully since if the ice dam held, and the lake overflowed into a nearby creek, a valuable steelhead fishery would be destroyed. The new lake rose an average of 0.6 feet/day in summer and early fall before the dam began to break on October 7. Glaciologists predict that Russell Fjord will continue to fill and drain, and since Hubbard Glacier is advancing again, it is predicted that the fjord will turn into a lake again in 1987. (Wood-PTT)
W88-04134

MEASUREMENT OF THE ENTRAPMENT OF SULFUR DIOXIDE BY RIME ICE,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W88-04137

SPATIAL DISTRIBUTION OF CHLORIDE AND SULFATE IN THE SNOW COVER IN SAPPORO, JAPAN,
Tokyo Metropolitan Univ. (Japan). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W88-04138

COMPARISON OF SNOW COVER LIQUID WATER MEASUREMENT TECHNIQUES,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 7B.
W88-04304

2D. Evaporation and Transpiration

PLANT WATER POTENTIAL MEASURED CONTINUOUSLY IN THE FIELD,
National Vegetable Research Station, Wellsbourne (England).
T. McBurney, and P. A. Costigan.
Plant and Soil, PLSOA2, Vol. 97, p 147-149, January 1987. 3 fig, 6 ref.

Descriptors: Descriptors:*Plant water potential, *Monitoring, *Soil water, *Psychrometers, Irrigation, Soil temperature, Temperature, Brussel sprout, Vegetables.

A simple system is described which allowed the use of a stem attached psychrometer in the field. Water was circulated between a tank buried in the soil and the psychrometer and this system reduced temperature gradients sufficiently to enable continuous measurements of plant water potential to be made in the field. Measurement confirmed with those taken independently with a destructive pressure chamber method. (Author's abstract)
W88-03660

EVALUATION OF SIMPLE, DYNAMIC SOIL MOISTURE MODEL,
Portland State Univ., OR. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W88-03781

RELATIONS BETWEEN REMOTELY SENSED CANOPY TEMPERATURE, CROP WATER STRESS, AIR VAPOR PRESSURE DEFICIT AND EVAPOTRANSPIRATION IN CHICKPEA,
Space Application Centre, Ahmedabad (India).
S. K. Saha, A. K. S. Gopalan, and D. S. Kamat.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 17-26, October 1986. 6 fig, 24 ref.

Descriptors: *Canopy temperature, *Remote sensing, *Crop water stress, *Air vapor pressure deficit, *Evapotranspiration, *Chickpea.

Canopy temperature is an indicator of crop water stress. The concept of stress degree day (SDD), which is mid-day canoy and air temperature differential, has been proposed as an index of crop water stress. The concept of crop water stress index (CWSI) is used to account for the effect of environmental factors such as air vapor pressure deficit (VPD), net radiation and wind speed on the water status of a crop. Field studies wer conducted on differentially irrigated chickpea to investigate the potential use of remotely sensed canopy temperature-derived stress degree day (SDD) and crop water stress index (CWSI) to asseas crop water stress and to evaluate empirical relationships between canopy temperature, air vapor pressure deficit (VPD) and evapotranspiration (ET). Canopy temperature was measured with a hand-held infrared thermometer; canopy reflectances in red and infrared bands were measured using a hand-held radiometer. Soil water content and weather variables were also recorded. Results showed that indices such as SDD and CWSI, along with an IR/Red reflectance ratio, are useful for the assessment of water stress in chickpea. Canopy air temperature differential was inversely related to VPD as well as to ET in both irrigated and unirrigated chickpea. (Ray-PTT)
W88-03872

NUMERICAL ANALYSIS OF PINE FOREST EVAPORATION AND SURFACE RESISTANCE,
Sveriges Lantbruksuniversitet, Uppsala.
A. Lindroth, and S. Halldin.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 59-79, October 1986. 8 fig, 1 tab, 36 ref.

Descriptors: *Numerical analysis, *Pine trees, *Evaporation, *Surface resistance, *Penman equation, *Water balance, *Energy balance/Bowen ratio, Forests, Model studies.

Predication of forest evaporation with the Penman equation that includes a surface resistance term, is still hampered by the lack of understanding of this resistance term. A well-established, steady-state, multi-layer model was used to simulate evaporation of a pine forest in central Sweden, where previous measurements had shown a large difference between evaporation estimated by energy balance/Bowen ratio (EBBR) and water balance methods. Model input was profiles of turbulent diffusivity, boundary layer resistance, stomatal resistance, wind speed, net and global radiation and needle area density. The surface resistance, rss, as defined by the Penman equation, was always less than bulk stomatal resistance, rst. For a projected needle area index (LAI) of around 1.5 the rss/rst quotient was 0.5 but for values of LAI $>$ 4 or 5 it attained a constant value around 0.9. When ground evaporation was excluded, the canopy surface resistance, rsc, was very close to rst (rsc/rst=0.95) for all LAI. Bulk stomatal resistances based on point values of stomatal conductance, implied rss/rst and rsc/rst values largely differing from unity. The operational definition of average stomatal resistance was, therefore, an important point. Simulated evaporation for representative days of the 'discrepancy' period gave support to EBBR measurements. It was suggested that different local representativity might explain differences between the evaporation estimation methods. A sensitivity analysis showed that vapor pressure deficit and radiation were equally important to determine forest evaporation but net radiation influenced it indirectly through the surface resistance. (Author's abstract)
W88-03873

MORECS DISCUSSION MEETING: APRIL 1981.
Institute of Hydrology, Wallingford (England).

Report No. 78, August 1981. Edited by C. M. K. Gardner. 57 p.

Descriptors: *Soil water, *Model studies, *Soil moisture deficiency, *Evaporation, *Hydrologic budget, Models, Percolation, Rainfall, Moisture deficiency, Agriculture, Soil moisture meters, Soil profiles, Transpiration, Seepage.

This report contains ten papers presented at a meeting held at the Institute of Hydrology in April 1981 to discuss the Meterological Office Rainfall and Evaporation Calculation Scheme (MORECS). The emphasis of the meeting was on the estimation of soil moisture deficits. The papers covered the following topics: a description of MORECS; the soil moisture extraction model; problems arising from the field capacity concept in comparing measured soil moisture deficits with MORECS predictions; preliminary comparisons between MORECS and measured soil moisture deficits; the prediction of soil moisture deficit (an operational approach); an agricultural perspective of MORECS; a hydrological perspective of MORECS; comparison of field data with water budget calculations; estimation of soil moisture excess, and verification; and comparison of MORECS with catchment data. (Geiger-PTT)
W88-03952

MORECS,
Institute of Hydrology, Wallingford (England).
N. Thompson.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 1-10, 2 fig, 3 tab, 4 ref.

Descriptors: *Models, *Soil moisture deficiency, *Evaporation, *Soil water, *Rainfall, Meteorological data collections, Model studies, Percolation, Hydrologic budget, Mathematical models, Evapotranspiration, Mathematical equations.

MORECS (Meteorological Office Rainfall and Evaporation Calculation Scheme) replaced the Estimated Soil Moisture Deficit bulletins as a method of calculating soil moisture. MORECS is published weekly and uses the modified Penman-Monteith method. The meteorological variables (sunshine, temperature, vapor pressure, wind speed and rainfall) are extracted daily from the Synoptic Data Bank at Bracknell, and from these are obtained grid-square values by interpolation and weekly averages. Each grid is 40 by 40 km. Estimates of weekly potential evapotranspiration (PE) are then made from the weekly-averaged inputs, from which the PE's are estimated each day by a sunshine correction method. The daily meteorological data inputs are obtained from about 125 synoptic stations distributed widely over Great Britain. Inverse distance weighting is used when there are less than three stations. Rainfall interpolation is handled by expressing the measured daily values as a percentage of long-term average, and then interpolating these percentages. Calculation of daily PE for each grid relies on the Penman-Monteith equation. MORECS uses a soil moisture extraction model and calculates the soil moisture balance from the estimated rainfall and actual evaporation. Such a system involves many assumptions and will probably be ineffective in describing deep percolation. The new version of MORECS produces outputs for soils of low, medium and high available water capacity. (Geiger-PTT)
W88-03953

SOIL MOISTURE EXTRACTION MODEL,
Institute of Hydrology, Wallingford (England).
C. M. K. Gardner.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 11-14, 3 ref.

Descriptors: *Soil water, *Models, *Evaporation, *Rainfall, *Soil moisture deficiency, Soil-water-plant relationships, Moisture deficiency, Agriculture, Percolation, Soil profiles, Surface runoff, Model studies, Transpiration.

The MORECS (Meteorological Office Rainfall and Evaporation Calculation Scheme) system calculates daily grid square values of potential evaporation and rainfall. These values are modified to allow for the evaporation of intercepted rainfall and then used by the soil moisture extraction model to produce daily soil moisture deficit (SMD) values for several crop types in each grid square. The model is based on that devised by Penman and uses a two layer structure to represent the response of the soil to incoming rain and the demand of the plant for water. The bottom layer is always 1.5 the capacity of the top layer which is known as MAX. The MORECS soil moisture extraction model incorporates both the field capacity and the root constant concepts. Because of the reliance on the field capacity concept, according to the model, drainage may only occur if the soil profile moisture content is at or greater than field capacity, and during deficit periods, the only water losses allowed from the profile are in the form of transpiration and evaporation. The only water input to the profile accounted for is rainfall and no allowance is made for surface runoff during intense rainfalls, or on steep slopes. MORECS discriminates to a certain extent between soils of different water holding properties through the use of three MAX values for each crop. The values of MAX are critical in determining the success of the system in estimating SMD. (Geiger-PTT)
W88-03954

PROBLEMS ARISING FROM THE FIELD CAPACITY CONCEPT IN COMPARING MEASURED SOIL MOISTURE DEFICITS WITH MORECS PREDICTIONS,
Institute of Hydrology, Wallingford (England).
J. P. Bell.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 15-19, 5 fig.

Descriptors: *Soil profiles, *Soil moisture deficiency, *Soil water, *Models, *Field capacity, Soil-water-plant relationships, Model studies, Surface runoff, Percolation, Conductivity, Drainage, Prediction, Error analysis.

Meteorological models for predicting soil moisture deficit (SMD) such as MORECS (Meteorological Office Rainfall and Evaporation Calculation Scheme) depend on the validity of field capacity because they take account only of inputs and outputs of water at the soil surface once the integrated profile water content is at or below field capacity. No provision is normally made for further drainage nor for upward fluxes across the base of the profile. A reproductive field capacity condition can generally be established where soil conductivity is provided principally by a macropore system, the matrix being very poorly conductive. The field capacity condition can also be reproducible in much more conductive soils. In the hybrid situation, where there is intermediate conductivity and deeper water tables, there is no reproducible field capacity. These problems give rise to a discrepancy between the measured and predicted dates from the onset of deficit conditions in the spring. Also, it is not clear whether deficit should be considered to relate to a constant profile depth and hence include an unquantifiable drainage component, or whether it should relate to a charging but unknown depth of profile above the zero flux plane. If deficits are conceived of as relating to a constant profile depth, it is unclear as to how provisions can be made for different soil/crop/water table situations. (Geiger-PTT)
W88-03955

PRELIMINARY COMPARISONS BETWEEN MORECS AND MEASURED SOIL MOISTURE DEFICITS,
Institute of Hydrology, Wallingford (England).
C. M. K. Gardner.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 20-27, 8 fig.

Descriptors: *Soil moisture deficiency, *Soil water, *Error analysis, *Models, *Evaporation, Moisture deficiency, Model studies, Field capacity, Evaporation rate, Comparison studies.

Comparisons have been made between soil moisture deficits (SMD) measured at grassland sites in southern England and MORECS (Meteorological Office Rainfall and Evaporation Calculation Scheme) SMD values. Preliminary results showed reasonable agreement between the timing of the peaks and troughs of the pairs of curves obtained from the two methods, and in some instances, between the timing of the onset and termination of the main deficit period each year. However, MORECS consistently over-estimated the deficit measured in the top meter. MORECS might have over-estimated the deficit because the calculated potential evaporation value (Ep) might be too high, the MAX (moisture capacity of the top layer of soil) values could be too large, and/or relationship of the Ea (actual evaporation): Ep ratio with SMD which comes into effect when the SMD exceeds MAX may be inappropriate. By reducing the MAX value the developing SMD reaches the MAX threshold earlier in the season and so the consequent reduction in evaporation rate is introduced earlier and the maximum allowable deficit (2.5 MAX) is smaller and is reached sooner. The incorporation of more appropriate surface resistance values into the system should improve the SMD estimates. (Geiger-PTT)
W88-03956

PREDICTION OF SOIL MOISTURE DEFICIT: AN OPERATIONAL APPROACH,
Institute of Hydrology, Wallingford (England).
I. R. Calder, R. J. Harding, and P. T. W. Rosier.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 28-35, 5 fig, 2 tab, 6 ref.

Descriptors: *Mathematical models, *Soil moisture deficiency, *Models, *Model testing, Moisture content, Performance evaluation, Soil profiles, Mathematical studies, Soil water, Soil-water-plant relationships, Model studies, Prediction, Hydrologic models, Soil moisture meters, Mathematical equations.

This paper examines ways in which the performance of soil moisture deficit (SMD) models may be improved by the inclusion of more detailed equations for estimating both potential evaporation and more complex root constant functions which relate actual evaporation to potential via the moisture status of the soil. Some three thousand neutron probe observations of total soil moisture content of the profile were used. The study started with the simplest conceivable soil moisture deficit prediction model and then assessed what improvements in accuracy could be obtained by incorporating progressively more detailed equations for estimating potential evaporation and root constant regulating functions. Thirty different models were formulated using four basic assumptions, and all combinations of five component potential evaporation equations and six component root constant functions. Model performance was assessed by the classical goodness of fit criteria. Results showed that the best model fits are obtained with parameter optimization. Without parameter optimization the most successful SMD models are those incorporating the layer regulating function. The potential evaporation equations incorporating either the climatological mean or the Penman formulations are the most successful. The Thom-Oliver and Priestly-Taylor formulations produce relatively poor fits. The constant formulation produced the worst fits. (Geiger-PTT)
W88-03957

MORECS: AN AGRICULTURAL PERSPECTIVE,
Nottingham Univ. (England). Dept. of Physiology and Environmental Science.
For primary bibliographic entry see Field 3F.
W88-03958

ESTIMATION OF SOIL MOISTURE EXCESS, AND VERIFICATION,
Thames Water Authority, Reading (England). Thames Conservancy Div.

B. J. Greenfield.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 43-45, 4 fig.

Descriptors: *Models, *Soil moisture deficiency, *Percolation, *Soil water, *Model testing, Evaporation, Moisture deficiency, Model studies, Soil-water-plant relationships, Hydrologic models, Mathematical models, Mathematical studies, Surface runoff.

It is important to consider soil moisture excess rather than deficit when assessing the performance of a soil moisture model since the generation of apparently reasonable deficits does not ensure the generation of reasonable estimates of excess. One method of testing estimates of soil moisture excess is to use a catchment storage model and to compare generated and observed river flows. Using this method, the drying curve concept can produce reliable estimates of soil moisture excess provided one basic modification is made to the model and provided an appropriate drying curve is used. To compensate for the deficiency of the absence of summer percolation in the traditional (Penman) approach, a simple allowance of 15% of rainfall excess over potential evaporation on any day bypassing the soil moisture store may be used to provide the right order of summer percolation. The groundwater model approach may be extended to provide estimates of seasonal maximum actual deficit which in turn may be used to derive the optimum drying curve slope and root constant for a specific application. At Thames Water, the root constant value for grassland was found to vary from 25 mm to 75 mm according to underlying geology, but the drying curve slope has a constant value of about 0.3 for all areas. Deficits attained in 1976 indicate that there is no validity in the concepts of maximum deficit. (Geiger-PTT)
W88-03959

COMPARISON OF MORECS WITH CATCHMENT DATA,
Severn-Trent Water Authority (England).
G. Davies.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 46-48, 2 fig, 1 ref.

Descriptors: *Models, *Evaporation, *Soil moisture deficiency, *Catchment areas, *Comparison studies, Moisture deficiency, Rainfall, Prediction, Model studies, Soil-water-plant relationships, Model studies, Hydrologic models, Soil water, Mathematical models, Mathematical studies, Model testing, Surface runoff, Catchment basins.

The data obtained from MORECS (Meteorological Office Rainfall and Evaporation Calculation Scheme) was compared with data for a natural catchment with little groundwater storage (the Rea Brook catchment) for the period January 1979 to December 1980. A computer program was used to calculate daily catchment estimates of actual evaporation, soil moisture deficit and effective rainfall using the root constant concept and Penman's drying curves and keeping an independent budget for each land use type. Annual totals of potential evaporation as calculated by MORECS were significantly higher than the catchment estimates by 12% in 1979 and 31% in 1980. Similarly, MORECS estimates of actual evaporation were higher by 22% in 1979 and 24% in 1980. In 1979, MORECS estimates of SMD (soil moisture deficit) returned to field capacity slightly later than the catchment values. However, in 1980, MORECS values were significantly higher from June onwards, not reaching zero by the end of December, whereas the SMD for the Rea Brook catchment returned to field capacity during October. MORECS estimates of effective rainfall were significantly lower than the catchment values, by 10% in 1979 and 36% in 1980. Values of catchment runoff for both years agree very closely with the catchment estimates of effective rainfall. This simple study shows that the use can be made of river flow data to check catchment estimates of SMD and effective rainfall. (Geiger-PTT)
W88-03960

ENERGY BALANCE APPROACH TO DETERMINE REGIONAL EVAPOTRANSPIRATION BASED ON PLANETARY BOUNDARY LAYER SIMILARITY THEORY AND REGULARLY RECORDED DATA,
Ahmadu Bello Univ., Zaria (Nigeria). Inst. for Agricultural Research, Irrigation Research Program.
S. Abdulmumin, L. O. Myrup, and J. L. Hatfield.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2050-2058, November 1987. 9 fig, 3 tab, 37 ref.

Descriptors: *Energy, *Evapotranspiration, *Mathematical analysis, *Theoretical analysis, *Data interpretation, Solar radiation, Mathematical studies, Mass transfer, Heat transfer.

An energy balance procedure was developed to determine regional evapotranspiration using only regularly recorded solar radiation and rawinsonde data. The major input terms in the basic energy balance equation are daily surface net radiation and sensible heat flux. Net radiation was determined by empirical and semiempirical radiation balance equations and the sensible heat flux term from an aerodynamic mass transfer equation derived from concepts of planetary boundary layer similarity theory. The procedure gave better results for a small (100 ha) agricultural watershed than a comparable procedure based on purely aerodynamic mass transfer considerations, especially on 1- and 2-day periods. For a larger (1000 ha) hydrologic watershed the model achieved acceptable accuracy for monthly estimates of regional evapotranspiration. On this time scale, comparison with observation yielded slopes from 0.97 to 1.14 with correlations between 0.90 and 0.91. For the monthly comparison, the purely aerodynamical model achieved virtually the same accuracy. These results were obtained using the same data set that was used to calibrate the model. When independent data were used, the accuracy for the monthly estimate degraded (slope 0.75, correlation 0.40). For bimonthly estimates, accuracy improved (slope 0.92, correlation 0.73). (Author's abstract)
W88-04182

MODELING OF EVAPOTRANSPIRATION FROM HOMOGENEOUS SOILS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
M. S. Markar, and R. G. Mein.
Water Resources Research WRERAO, Vol. 23, No. 10, p 2001-2007, October 1987. 8 fig, 2 tab, 27 ref.

Descriptors: *Evapotranspiration, *Homogeneous soils, *Model studies, *Soil water, Evaporation, Mathematical equations, Mathematical models, Mathematical studies, Transpiration, Water loss, Soil profiles, Computers, Prediction.

A sink term to simulate the removal of water by evapotranspiration from the soil profile was added to the moisture flow model of Clapp (1982). The resultant model gives results comparable to those obtained from a finite difference solution of the Richards equation modified for transpiration, but only uses about 5% of the computer time. Virtually all of the parameters required as input to model evapotranspiration are measurable, al beit with difficulty; they include the characteristic curves for the soil, the root distribution extraction function, the potential evaporation and transpiration rates, and the initial moisture profile. Example applications show that the model is capable of predicting evapotranspiration rates form homogeneous soils without using fitted parameters. (Wood-PTT)
W88-04322

2E. Streamflow and Runoff

PRACTICAL APPROACH TO THE EVALUATION OF THE CONSERVATION STATUS OF VEGETATION IN RIVER CORRIDORS IN WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W88-03588

EXPERT SYSTEM APPROACH TO THE ASSESSMENT OF THE CONSERVATION STATUS OF RIVERS,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
For primary bibliographic entry see Field 2H.
W88-03589

FLOOD IN THE DESERT,
Eckhoff, Watson, Preator Engineering, Salt Lake City, UT.
D. W. Eckhoff.
Civil Engineering CEWRA9, Vol. 57, No. 3, p 40-44, March 1987.

Descriptors: *Flood control, *Deserts, *Evaporation, *Great Salt Lake, *Pumping, *Saline lakes, *Water level fluctuations, Economic aspects, Lakes, Computers, Flood damage, Weirs, Dikes, Return flow, Brines.

The sharp rise of the Great Salt Lake during the past four years had caused considerable damage to industry and lake side property. Through 1985 flood damages were estimated to be $250 million. In 1986, after the Utah Division of Water Resources investigated a variety of alternative methods for dealing with the flooding, the state authorized the expenditure of $60 million of the West Desert Pumping Project. The project will push lake water to a natural basin in the West Desert crating a 500 sq mile pond. Roughly 40% of this water will evaporate, which will reduce the peak level of the lake between 6 and 12 inches annually. All features of the project have been bid at $53.3 million. Annual operating costs are estimated at $2 million. There are three main operational components of the project: a pumping plant, a discharge canal, and the West Pond. The pumping station will house three large vertical axial-flow propeller type pumps with 11-foot diameter tubes driven by natural gas engines. The discharge canal has an overall length of 4 miles and requires about 3 million cubic yards of excavation. Return flow of concentrated brine from the West Point will be discharged into the Great Salt Lake. The first pump is expected to be on line by March 1987. (Main-PTT)
W88-03604

SOME REFINEMENTS OF THE CONTRACTION AND RESISTANCE COEFFICIENTS IN THE CASE OF A SUDDEN CONTRACTION OF THE FLOW,
For primary bibliographic entry see Field 8B.
W88-03624

RESISTANCE TO FLOW IN GRAVEL-BED RIVERS,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
D. I. Bray, and K. S. Davar.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 7786, 1987. 4 fig, 2 tab, 37 ref.

Descriptors: *Bed load, *Sediment transport, *Flow resistance, *Gravel-bed rivers, *Resistance, *Flow, *River flow, *Hydraulics, Flow characteristics, Velocity, Friction factor, Gravel-bed rivers, Rivers.

Understanding the process responsible for resistance to flow is important in critically reviewing the assumptions and limitations associated with the methods that are commonly adopted to evaluate resistance to flow in gravelbed rivers. A commonly applied technique for estimating the local effective boundary roughness, k, uses data from a vertical velocity profile. Methods of estimating bulk measures of resistance to flow in a river reach are also outlined. Resistance equations in terms of the friction factor parameter, 1/square root of f, are classified into three main types: dimensional power equations, nondimensional power equations, and nondimensional semilogarithmic equations. The results of seven independent studies are considered

when reccomending tentative equations for each of the three defined classes of resistance equations. The bulk flow equations are considered to be applicable for the case where d/D50 is greater than 10, there is no bedload transport, and the flows are inbank flows. Finally, the problems of estimating resistance to flow for an ice covered channel are reviewed. (Author's abstract)
W88-03642

STOCHASTIC REAL-TIME SPRING FLOOD FORECASTING SYSTEM FOR CARMAN, MANITOBA,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W88-03643

USE OF SNOW-PILLOW DATA FOR MELT RATE INPUT TO THE STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION WATERSHED MODEL,
Alberta Environment, Edmonton.
S. J. Ferner, and J. M. Wigham.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 118-126, 1987. 7 fig, 23 ref.

Descriptors: *Streamflow forecasting, *River forecasting, *Runoff forecasting, *Snowmelt, *Model studies, *Runoff, *Forecasting, Reservoirs, Watersheds, Snow pillows, Alberta.

A split watershed version of the streamflow synthesis and reservoir regulation (SSARR) model was calibrated and verified for Marmot Creek, a small forested research watershed located in the Rocky Mountains west of Calgary, Alberta. The model was used for forecasting runoff rates. Melt rate data from five snow pillows, located at sites of different elevation and exposure on the basin, were applied to the model. The melt-rate factor expressed in millimeters per degree-day was the only input parameter changed in the model, which was run for the months of April, May, and June over an 8-year period, 1973-1980. An average melt rate from the snow covered area as determined from the five snow pillows provided the best runoff simulation. Measured melt rates from just one snow pillow, located at the middle elevation of the basin in a heavily forested area, provided a comparable simulation. Snow pillows located at lower elevations in either open or closed areas and snow pillows located at higher elevations in open areas yielded poor simulations. The characteristics and problems associated with the use of snow pillow for modelling snowmelt are also discussed. (Author's abstract)
W88-03644

CHIRONOMID MORTALITY AFTER THE SANDOZ ACCIDENT AND DEFORMITIES IN CHIRONOMUS LARVAE DUE TO SEDIMENT POLLUTION ON THE RHINE,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5C.
W88-03763

LIMNOLOGICAL CHARACTERISTICS, WATER QUALITY AND CONSERVATION MEASURES OF A HIGH ALTITUDE BOG AND RIVERS IN THE MALUTI MOUNTAINS, LESOTHO,
Orange Free State Univ., Bloemfontein (South Africa).
For primary bibliographic entry see Field 2H.
W88-03769

CANAL DESIGN: OPTIMAL CROSS SECTIONS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 8B.
W88-03784

EVALUATING PARTIAL AREAS OF WATERSHED RUNOFF,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 356-366, August 1987. 6 fig, 2 tab, 13 ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Storage capacity, *Watersheds, *Rainfall, Storms, Australia, Catchment areas, Overland flow, Hydrology, Hydrologic budget, Estimating.

Variations in surface storage capacity over a watershed produce partial areas of saturation overland flow, which vary from storm to storm. A method is described by which the proportions of a watershed that contribute overland flow in different storms and at different times during the same storm can be determined by analysis of rainfall and runoff records. The method is demonstrated on two catchments in Queensland, Australia, with different hydrological characteristics. One watershed is 16.8 ha in area with only two to three events per year of overland flow (no baseflow) averaging 35 mm per annum runoff; the other is 7 km in area with substantial baseflow and an average of 920 mm per annum runoff. The calculated amounts and proportions of surface storage capacity are incorporated into water balance models of watershed runoff to show the accuracy of runoff estimation. (Author's abstract)
W88-03785

POLLUTANT WASHOFF BY OVERLAND FLOW,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-03798

DERIVATION OF FLOW DURATION CURVES IN NORTHERN IRELAND,
Ulster Univ., Coleraine (Northern Ireland). Dept. of Environmental Studies.
D. N. Wilcock, and J. E. Hanna.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 83, No. 2, p 381-396, June 1987. 4 fig, 6 tab, 10 ref.

Descriptors: *Equations, *Flow duration curves, *Hydrology, *Northern Ireland, *Duration curves, Baseflow, Estimating, Catchment areas, Flow.

The method of synthesizing flow duration curves (FDCs) outlined in the Institute of Hydrology's 1980 Low Flow Studies Report (LFSR) is applied to Northern Ireland, a part of the British Isles which provided few data for inclusion in the Institute's report. Using a base flow index term (BFI) derived from flow records at fourteen gauging stations, the method works well, and there is no systematic tendency to over- or underestimate Q sub 95. High flows, however, do tend to be underestimated. One difficulty in using the LFSR method in Northern Ireland is the non-availability of maps from which to obtain independent measures of BFI. Therefore, an alternative method of synthesizing FDCs from catchment characteristics is considered. The two methods of FDC synthesis are tested on independent data, the LFSR method performing slightly better than the catchment equations at Q sub 95 flows but less well at flows above Q sub 90. (Author's abstract)
W88-03805

PERFORMANCE OF SODIUM AS A TRANSPORT TRACER-EXPERIMENTAL AND SIMULATION ANALYSIS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03890

HYDROLOGY OF THE PRICE RIVER BASIN, UTAH, WITH EMPHASIS ON SELECTED COAL-FIELD AREAS,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03904

FLOODS OF APRIL 1979, MISSISSIPPI, ALABAMA, GEORGIA,
Geological Survey, Reston, VA. Water Resources Div.
G. W. Edelen, K. V. Wilson, J. R. Harkins, J. F. Miller, and E. H. Chin.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Professional Paper 1319, 1986. 212 p, 47 fig, 10 tab, 13 ref.

Descriptors: *Pearl River basin, *Flood hydrographs, *Mobile River basin, *Floods, *Flood frequency, *Historic flood, *Reservoir stages, Meteorology, Reservoir storage, Frequency analysis, Peak stage, Peak discharge, Rainfall distribution, Flood magnitude, Flood profiles, Groundwater fluctuations, Mississippi, Alabama, Georgia.

A major storm April 11-13, 1979, following a series of storms in March and April, brought large amounts of rainfall over southeastern United States. Heaviest rain fell over north-central Mississippi and Alabama. A maximum of 21.5 inches was observed at Louisville, 14 SE, Mississippi. Floods in Mississippi and Alabama were the maximum of record at 60 streamflow gaging stations in the Coosa, Alabama, Tombigbee, Chickasawhay, Pearl, and Big Black River basins. On the Pearl River, peak discharges at main stem gaging stations generally approached or exceeded those of the great flood of 1874, and recurrence intervals generally were greater than 100 years. Nine lives were reported lost. Estimated damages totaled nearly $400 million. Seventeen thousand people were driven from their homes in Jackson, Mississippi. This report presents analyses of the meterological settings of the storms, summaries of flood stages and discharges at 221 streamflow gaging stations, stages and contents of 10 reservoirs, flood-crest stages and hydrograph data consisting of gage height, discharge, and accumulated runoff at selected times, at 46 gaging stations, groundwater fluctuations in 11 observation wells, and water salinity and temperature at 22 sites along the Intracoastal Waterway in Mobile Bay. (USGS)
W88-03908

NATIONAL WATER SUMMARY 1984--HYDROLOGIC EVENTS, SELECTED WATER-QUALITY TRENDS, AND GROUNDWATER RESOURCES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03910

WATER IN THE UPPER YAKIMA RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
H. E. Pearson.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Washington State Department of Ecology, Olympia, Water-Supply Bulletin 52, 1983. 220 p, 12 fig, 1 plate, 2 tab, 45 ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Water use, *Washington, Hydrologic cycle, Irrigation effects, Water quality standards, Upper Yakima River basin, Water-Resource-Inventory areas.

The upper Yakima River basin, composing about one-third of the drainage area of the Yakima River, encompasses a wide range of climatic zones and topographic features in central Washington State. The upper part of the 2,135-sq mi study area is on the moist, heavily forested, eastern slope of the Cascade Range, and the lower part is in the semi-arid fringe of the Columbia Plateau. The central part of the study area is in the flat agricultural lowland of the Kittitas Valley. The present (1980) economy of the study area is based principally on agriculture and livestock production and related food processing in the Kittitas Valley, with some timber harvesting and recreational activities (skiing, hunting, and fishing) in the mountains. The

agricultural development in the Kittitas Valley has relied almost entirely on water carried in irrigation canals and laterals from the Yakima River. The large livestock population also utilizes canal water, along with groundwater. Groundwater in the study area occurs principally in unconsolidated valley-fill deposits--sand, gravel, silt, and clay. These alluvial materials underlie the Kittitas Valley and floodplains of the major river valleys. Groundwater also occurs in older, semiconsolidated sand-and-gravel units and in fracture zones in basalt layers. (USGS)
W88-03929

WATER IN THE LOWER YAKIMA RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
D. Molenaar.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Washington State Department of Ecology, Olympia, Water-Supply Bulletin 53, 1985. 159 p, 38 fig, 32 tab, 113 ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Water use, *Washington, Hydrologic cycle, Irrigation effects, Water quality standards, Lower Yakima River basin, Water-Resource-Inventory areas.

This report represents a compilation and general interpretation of hydrologic data collected in the lower Yakima River basin, one of the major Water-Resource Inventory Areas of the State of Washington. The report is one of a series prepared in cooperation with the State of Washington Department of Ecology (DOE) for use by Federal, State, County, and municipal agencies involved in the use and management of the State's land and water resources. This report also may serve as a guide to individuals and private companies interested in the local availability of surface and groundwater and in the quality of the water. The study included the assembly, compilation, and interpretation of available hydrologic information on the area. Although considerable data are available, some dating back to the mid- to late 1800's, most of the interpretations are based on data covering the 1960-77 water years; some later data for the period through 1979 are included. The data include records of precipitation (as rain and snow), storage of water in lakes and reservoirs, records of discharges of streams, canals and drains, and related water quality, records of wells, drillers' logs of materials penetrated and water-yielding characteristics of aquifers tapped (as determined from pumping tests), and analyses of groundwater quality. Evaluation also was made of data of surface- and groundwater use for municipal, industrial, and irrigation supplies. This report also makes use of data presented in existing reports and interpretations of those data where pertinent. (USGS)
W88-03930

GROWTH AND SURVIVAL OF PERITRICH CILIATES IN AN URBAN STREAM,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-04009

AQUATIC MICROBIAL ACTIVITY AND MACROFAUNAL PROFILES OF AN OKLAHOMA STREAM,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 5B.
W88-04019

REAL-TIME FLASH FLOOD PREDICTION,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
K. P. Georgakakos.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9615-9629, August 1987. 9 fig, 2 tab, 23 ref. National Weather Service Contract 40AANW602376.

Descriptors: *Hydrologic models, *Flash Floods, *Flood forecasting, *Flood routing, *Rainfall-runoff relationships, Sensitivity analysis, Hydrologic data collections, Meteorological data collection, Model studies, Runoff forecasting.

A prototype hydrometeorological model for real-time, site-specific, flash flood prediction is presented. Precipitation prediction components are coupled with runoff-generating and flood-routing components through the water mass conservation law and a state estimator which was used for updating the model state variables from real-time observations. The model is capable of operating under the various data prone areas. Sensitivity analysis using data from significant past flash floods indicates that short-term model predictions are not significantly sensitive to the runoff-generating model component when updating is performed. In addition, the sensitivity analysis suggested that model performance is best when all available meteorological and hydrological data are utilized by the state estimator. Remarkably (given the data available for calibration) good predictions of stream stage were obtained by the model for several flash flood cases. (Author's abstract)
W88-04104

MAIN CHANNEL LENGTH-AREA RELATIONSHIP FOR CHANNEL NETWORKS,
Universidad Nacional de Colombia, Medellin.
For primary bibliographic entry see Field 2J.
W88-04189

STREAM REGULATION IN ARGENTINA, INCLUDING THE SUPERIOR PARANA AND PARAGUAY RIVERS,
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina).
For primary bibliographic entry see Field 6G.
W88-04227

ECOLOGICAL CONSIDERATIONS IN THE DEVELOPMENT AND APPLICATION OF INSTREAM FLOW-HABITAT MODELS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
D. J. Orth.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 171-181, April-June, 1987. 1 fig, 82 ref.

Descriptors: *Stream flow, *Instream flow, *Model studies, *Ecosystems, Stream ecology, Population dynamics, Ecological effects, Theoretical analysis.

Ecological factors relating to stream ecology, population dynamics, energetics, predation, and competition are reviewed to explain why indices of microhabitat availability are not expected to be consistent predictors of fish population density. The Instream Flow Incremental Methodology (IFIM) is a process which includes the evaluation of effects of incremental changes in stream flow on channel structure, water quality, temperature, and availability of suitable microhabitat to recommend a flow regime that will maintain existing habitat conditions. Current ecological theory and empirical studies support the hypothesis that microhabitat availability may limit fish populations but not continuously. Therefore, assessments must consider the limiting habitat events as well as temperature and water quality constraints. Also, invertebrates and non-game fishes must be considered in instream flow assessments because of their importance in stream ecosystems. The IFIM process has the potential to identify limiting habitat events and avoid them in developing flow regimes in regulated rivers. However, much additional research is needed before it will be possible to predict fish population sizes accurately under various flow regulation scenarios. (Lantz-PTT)
W88-04230

CHANNEL DEGRADATION IN THE MIDDLE ARVE RIVER, FRANCE,
Lyon-3 Univ. (France). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-04231

MIXING IN RIVER UNDERFLOW,
Western Australia Univ., Nedlands.
J. Imberger.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 697-715, June 1987. 12 fig, 45 ref.

Descriptors: *Mixing, *Underflow, *River flow, *Dams, Outflow, Diffusion, Mathematical studies, Richardson number, Flow profiles, Hydraulic properties.

Data is presented detailing the water motion in the Wellington Reservoir induced by the outflow from the valve at the base of the dam wall. This outflow system established a simple horizontal shear flow longitudinally along the axis of the reservoir, the characteristics of which are determined by the three-dimensional sink flow dynamics at the valve. The associated gradient Richardson number of this flow is 11.2; the vertical mass diffusion coefficient, estimated from temperature measurements, is 0.000006 sq m/sec; and the energy dissipation, obtained from microstructure profiles, is around 3.2 times 10 to the -9th sq m/cu sec. Together these measurements imply a flux Richardson number of 0.28. The large value of the gradient Richardson number computed from the sink flow velocity profile suggests that this mean velocity shear was augmented by a field of internal waves, which locally lowered the gradient Richardson number below the critical values. (Author's abstract)
W88-04232

NEGATIVELY BUOYANT FLOW IN A DIVERGING CHANNEL. I: FLOW REGIMES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 8B.
W88-04233

NEGATIVELY BUOYANT FLOW IN A DIVERGING CHANNEL. II: 3-D FLOW FIELD DESCRIPTIONS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 8B.
W88-04234

UPSTREAM CALCULATION OF CHARACTERISTICS FOR KINEMATIC WAVE ROUTING,
Lawrence Livermore National Lab., CA.
K. G. Eggert.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 743-752, June 1987. 5 fig, 1 tab, 9 ref, append. DOE Contract No. W-7405-ENG-48.

Descriptors: *Routing, *Flood routing, *Unsteady flow, *Kinematic waves, *Mathematical studies, *Wave routing, *Overland flow, Channel flow, Discharge hydrographs, Hydraulic models, Model studies.

A method is presented for calculating characteristics in the upstream direction for kinematic wave routing of overland and upland channel flow resulting from time-varying rainfall. This method allows convenient selection of a regular time step for the discharge hydrograph without sacrificing the precision of an analytical solution. The technique is useful for verification of numerical methods, or is appropriate for use in a watershed model where histogram lateral inflows are used. The accuracy of the method achieved is a function only of the convergence criteria used. (Lantz-PTT)
W88-04235

VELOCITY AND DISCHARGE IN COMPOUND CHANNELS,
Ulster Univ., Coleraine (Northern Ireland). Dept. of Civil Engineering.
W. R. C. Myers.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 753-766, June 1987. 10 fig, 1 tab, 17 ref, append.

Descriptors: *Flood flow, *Discharge measurement, *Flow velocity, *Channel flow, *Compound channels, Flow discharge, Flow patterns, Mathematical studies, Flood plains.

The problem of discharge assessment in compound channels is described, including the difficulty of accurately modeling main channel and floodplain flows. Theoretical considerations show that the ratios of main channel velocity and discharge to floodplain values in a compound channel are independent of bed slope and are influenced only by depth and geometry. This is also true for other significant velocity and discharge ratios. Experimental confirmation of these theoretical predictions is presented using data from three symmetrical compound channel shapes. The relationships are described mathematically where possible, and the exponents and coefficients are evaluated. Comparisons of measured discharges with values obtained using conventional methods that neglect the interaction between main channel and floodplains, shows the errors incurred by the conventional approach. The conventional approach overestimates channel and full cross-sectional carrying capacity at lower depths, while underestimating full cross-sectional capacity is underestimated at all depths of flow. (Lantz-PTT)
W88-04236

VEGETATION CHARACTERISTICS AND THE PREDICTION OF RUNOFF: ANALYSIS OF AN EXPERIMENT IN THE NEW FOREST, HAMPSHIRE,
Southampton Univ. (England). Dept. of Geography.
A. M. Gurnell, and K. J. Gregory.
Hydrological Processes HYPRE3, Vol. 1, No. 2, p 125-142, March 1987. 10 fig, 6 tab, 17 ref.

Descriptors: *Vegetation, *Runoff forecasting, *Forests, *Runoff models, *England, Hydrologic models, Flood peak, Storm hydrographs, Storms, Precipitation, Seasonal variation, Model studies.

Vegetation characteristics have not been sufficiently utilized in catchment runoff models. An analysis of storm hydrograph data from nested subareas of the Highland Water catchment, New Forest, U.K., indicates that depth of runoff and peak discharge from areas under heathland cover is substantially greater than from areas under woodland cover at several spatial scales. Analysis of runoff, precipitation and water table level observations, illustrates the fundamental influence of vegetation on the runoff response from heathland and forested drainage basins. Vegetation is not only influential in controlling initial losses from rainfall, but also in controlling the slope of the rainfall-runoff relationship for increasing amounts of precipitation up to moderate sized storms. Very large storms could not be studied because of the requirement for within-channel hydrographs. Figures contrast initial losses of approximately 2-4 mm from heath areas with losses of 4-6 mm from forested areas, and show persistently larger losses from woodland compared to heath for storm precipitation depths up to 28 mm. The vegetation composition of heath areas is particularly finely tuned to the underlying soil water regime. This property can be used to identify the spatial and temporal pattern of the area within a catchment which is likely to yield a high runoff response to rainfall. In ungaged heath catchments, it can be used to identify runoff contributing zones with precision and to refine the SOIL index required to estimate runoff from ungaged sites using the Flood Studies techniques. An analysis of the runoff characteristics of an ungaged catchment elsewhere in the New Forest, using this proposed addition to the mapping of Winter Rainfall Acceptance Potential (WRAP) categories, yielded an increase in the estimate of runoff response to rainfall from 15% to > 30%. (Lantz-PTT)
W88-04239

CATCHMENT RESPONSE TIME AS A PREDICTOR OF FLOOD QUANTILES,
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter, and E. B. Faulkner.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 857-861, October 1987. 2 fig, 4 tab, 7 ref. NSF Grant ECE-8514462.

Descriptors: *Flood forecasting, *Hydrographs, *Catchment response time, *Regression analysis, *Data interpretation, Drainage area, Floods, Flood quantiles, Wisconsin, Prediction, Mathematical studies, Flood peak, Flood flow, Catchment areas.

A regression analysis using a generalized least squares approach on flow data from the driftless area of Wisconsin indicates that the ratio of drainage area to time-to-peak is a good predictor of flood quantiles. The standard errors of prediction that result from the use of this ratio in the regression equations are lower than those resulting from existing equations. The estimation of time-to-peak (or some other measure of basin response time) requires direct measurement of river stage and possibly rainfall at the site of which the quantiles are to be estimated. The cost-effectiveness of such an approach must yet be determined. (Wood-PTT)
W88-04287

USE OF HISTORIC FLOOD INFORMATION IN ESTIMATING FLOOD PEAKS ON UNGAGED WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. J. Wall, D. F. Kibler, and M. E. Hastings.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 919-926, October 1987. 5 fig, 11 tab, 9 ref.

Descriptors: *Flood peak, *Flood frequency, *Estimating equations, *Flood data, *Data interpretation, *Pennsylvania, Mathematical equations, Floods, Flooding, Historic floods, Estimating, Flood forecasting, Mathematical equations, Inverse variance weighting.

Regional procedures to estimate flood magnitude for ungaged watersheds typically ignore available site-specific historic flood information such as high water marks and the corresponding flow estimates, otherwise referred to as limited site-specific historic (LSSH) flood data. A procedure to construct flood frequency curves on the basis of LSSH flood observations is presented. Simple inverse variance weighting is employed to systematically combine flood estimates obtained from the LSSH data base with those from a regional procedure to obtain improved estimates of flood peaks on the ungaged watershed. For the region in Pennsylvania that was studied, the variance weighted estimates of flow had a lower logarithmic standard error than either the regional or the LSSH flow estimates, when compared to the estimates determined by three standard distributions for gaged watersheds investigated in the development of the methodology. Use of the simple inverse variance weighting procedure is recommended when 'reliable' estimates of LSSH floods for the ungaged sites are available. (Author's abstract)
W88-04296

ASSESSING FLUSHING-FLOW REQUIREMENTS FOR BROWN TROUT SPAWNING GRAVELS IN STEEP STREAMS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. M. Kondolf, G. F. Cada, and M. J. Sale.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 927-935, October 1987. 2 fig, 2 tab, 25 ref. USDOE Contract DE-AC05-840R21400.

Descriptors: *Flushing flow, *Streams, *Spawning, *Trout, Dam effects, Dam releases, Sediment control, California, Gravel, Streamflow, Mathematical equations, Mathematical studies, Flow, Sedimentation, Ecology.

Flushing flows are releases from dams designed to remove fine sediment from downstream spawning habitat. The flushing flows were evaluated on reaches proposed for hydroelectric diversions on seven streams in the eastern Sierra Nevada, California, with wild populations of brown trout (Salmo trutta). The stream reaches are steep (average map slopes range from 7 to 17 percent), dominated by boulder cascades, and afford few opportunities for gravel deposition. Methods for estimating flushing flows from flow records, developed from studies in other localities, produced widely differing results when applied to the study streams, probably reflecting differences in the hydrologic and geomorphic characteristics of the streams on which the methods were developed. Tracer gravel experiments demonstrated that all sampled gravels were washed out by the flows of 1986, a wet year. Size analyses of gravel samples and hydraulic data from field surveys were used in tractive-force calculations in an attempt to specify the flow required to flush the gravels. However, these calculations produced some unrealistic results because the flows were nonuniform in the study reaches. This suggests that the tractive-force approach may not be generally applicable to small, steep streams where nonuniform flow conditions prevail. (Author's abstract)
W88-04297

IMPROVED ALGORITHMS FOR RESERVOIR CAPACITY CALCULATION INCORPORATING STORAGE-DEPENDENT LOSSES AND RELIABILITY NORM,
Indian Inst. of Science, Bangalore. Dept. of Computer Science and Automation.
S. M. Lele.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1819-1823, October 1987. 7 ref.

Descriptors: *Water yield, *Streamflow forecasting, *Reservoir operation, *Reservoir capacity, *Storage capacity, *Mathematical models, Hydraulic structures, Reservoirs, Evaluation, Planning, Capacity, Reservoir evaporation, Reservoir storage, Mathematical studies, Reservoir design, Mathematical equations, Model studies, Algorithms.

Two algorithms that improve upon the sequent-peak procedure for reservoir capacity calculations are presented. The first incorporates storage-dependent losses (like evaporation losses) exactly as the standard linear programming formulation does. The second extends the first to enable designing with less than maximum reliability even when allowable shortfall in any failure year is also specified. Together, the algorithms provide a more accurate, flexible and yet fast method of calculating the storage capacity requirement in preliminary screening and optimization models. (Author's abstract)
W88-04302

CROSS-CHANNEL MIXING AND ITS EFFECT ON SEDIMENTATION IN THE ORINOCO RIVER,
Princeton Univ., NJ. Dept. of Geological and Geophysical Sciences.
For primary bibliographic entry see Field 2J.
W88-04319

ONSET OF UNDERFLOW IN SLIGHTLY DIVERGING CHANNELS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 8B.
W88-04387

FLOOD PEAK ESTIMATES FROM LIMITED AT-SITE HISTORIC DATA,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. J. Wall, D. F. Kibler, D. W. Newton, and J. C. Herrin.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 1159-1174, September 1987. 1 fig, 9 tab, 12 ref, append.

Descriptors: *Flood peak, *Historic floods, *Mathematical studies, Data interpretation, Flow patterns.

Estimates of peak flood discharge on ungaged watersheds are often determined from regional relationships. This approach, however, ignores site-specific information that might be available from

sources such as historic high water marks, etc. A systematic procedure to estimate a given quantile flood, employing the limited at-site historic data, was developed for the ungaged watershed. In this procedure, the estimates of discharge based upon historic site-specific evidence are combined with independent regional estimates by inverse variance weighting, to obtain weighted estimates at the ungaged site. The variance of flow determined by the regional method was adequately represented by the square of the standard error of regression. The variance of flow determined on the basis of historic evidence was represented by the square of the regional standard error determined for gaged sites within the study region. The methodology based on inverse variance weighting appears to give better results than either independent estimate by itself, when compared to the station values at gaged sites within the study region. The simple inverse variance weighting procedure offers computational advantages over the optimal variance weighting scheme, with no sacrifice in accuracy. (Author's abstract)
W88-04405

1-D DAM-BREAK FLOOD-WAVE PROPAGATION ON DRY BED,
Demokritos Univ. of Thrace, Xanthi (Greece). School of Engineering.
C. V. Bellos, and J. G. Sakkas.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 12, p 1510-1524, December 1987.

Descriptors: *Dam failure, *Flood waves, *Floods, *Wave propagation, *Dry beds, *Hydrodynamics, Flow characteristics, Mathematical equations.

The complete hydrodynamic equations of the shallow-water theory in one dimension were employed to compute the flood wave resulting from the total and instantaneous collapse of a dam in a broad rectangular channel. The MacCormack numerical scheme was employed to solve the system of flow equations in a conservation-law form. The actual upstream and downstream boundary conditions of the flow field, i.e., a depth of flow equal to zero at these boundaries and beyond, were used for the solution of the flow equations. The results were compared with computational and experimental data obtained previously. Agreement between computational and experimental results regarding the wave-front advance and stage hydrographs was very satisfactory. The broad rectangular channel was employed for the purpose of comparing results. The method can easily be applied to channels of arbitrary cross-sectional shapes, as well as to almost any other unsteady open-channel flow problem by incorporating the appropriate initial and boundary conditions. (Lantz-PTT)
W88-04408

ANALYSIS OF THE U. S. GEOLOGICAL SURVEY STREAMGAGING NETWORK,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7A.
W88-04415

CRITIQUE OF THE REGIME THEORY FOR ALLUVIAL CHANNELS,
M. A. Stevens, and C. F. Nordin.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1359-1380, November 1987. 5 fig, 2 tab, 54 ref, append.

Descriptors: *Bed load, *Geomorphology, *Sediment transport, *Channel morphology, *Mathematical studies, *Alluvial channels, Theoretical analysis, Channel flow, Flow profiles, Hydrodynamics, Channels, Fluid mechanics.

In 1930, Lacey formulated Lindley's ideas on regime canals employing three sets of data, none of which were complete. In the next 55 years, the formulas have undergone scrutiny but are used today in a form quite similar to the original. Comparing Lacey's and subsequent regime equations to the laws of conservation of mass and to Newton's laws show that f sub VR is not = to f sub RS for almost all canals in regime, where f = d'Arcy-Weisbach friction factor, V = average velocity in the cross section, R = hydraulic radius, and S = slope of the channel bed; f sub VR is a measure of the concentration of sand being transported provided the transport is vanishingly small; f sub VR and f sub RS are uniquely related in all channels, rigid and alluvial, in which the kinematic wave number is one; and Lacey's roughness factor is heavily biased toward gravel and boulder channels. These findings do not detract from the geomorphic value of Lacey's regime. For engineering, however, a reformulation employing the conservation laws and Newton's laws is in order. (Author's abstract)
W88-04455

COMPARISON OF OVERLAND FLOW HYDROGRAPH MODELS,
Williamson and Schmid, Irvine, CA.
T. V. Hromadka, R. H. McCuen, and C. C. Yen.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1422-1440, November 1987. 12 fig, 12 ref.

Descriptors: *Unit hydrographs, *Routing, *Kinematic wave theory, *Overland flow, *Model studies, *Hydrographs, *Rainfall-runoff relationships, Mathematical analysis, Hydrodynamics, Hydraulic properties, Graphical analysis, Surface flow, Finite difference methods.

The diffusion equation is a simplification of the two-dimensional continuity and momentum equations. This simpler dynamic model of two-dimensional hydraulics affords the hydrologist a means to estimate flood flow effects for overland flow. A numerical model using the diffusion approach (DHM) was quickly applied to a set of idealized catchments to develop synthetic unit hydrograph S-graph equivalents. The model is based on an explicit, integrated finite-difference scheme, and the catchment is represented by topographic elevation and geometric data. Synthetic unit hydrographs (S-graphs) developed from use of the DHM were used to advance relationships between the unit hydrograph lag factor and the constant effective rainfall intensity used to generate the S-graphs. Sensitivity of the synthetic S-graphs to variations in idealized catchment size, slope, shape, friction parameters, and effective rainfall intensity were examined. Comparisons between linear and nonlinear unit hydrograph models, and a diffusion (DHM) and kinematic wave simplification of DHM were made for various time distributions of effective rainfall. Use of the standard SCS unit hydrograph provides a reasonable approximation of two-dimensional overland flow as predicted by a DHM or kinematic routing technique. (Author's abstract)
W88-04458

GRAPHIC ESTIMATION OF PEAK FLOW REDUCTION IN RESERVOIRS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. R. Horn.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1441-1450, November 1987. 5 fig, 10 ref, append.

Descriptors: *Graphical analysis, *Flood peak, *Reservoirs, *Hydrographs, Hydrologic properties, Channel flow, Flow profiles, Mathematical analysis.

A common problem in engineering hydrology is estimating the attenuation effects of storage reservoirs on peak inflow rates. While this may always be accomplished by a detailed hydrologic or hydraulic routing of the inflow hydrograph, approximate solutions are often desirable. A simple graphic procedure was developed to permit a direct determination of peak outflow as a function of parameters describing the inflow hydrograph, storage, and outlet characteristics. This procedure is based on the use of a dimensionless two-parameter inflow hydrograph and the solution of a nonlinear differential routing equation with reservoir storage expressed as an exponential function of outflow. Curves obtained from the results of the complete hydrograph routing indicate that the attenuation can be related to a dimensionless routing number, which in turn is defined by the reservoir and inflow parameters. The approach to provides an accurate solution for routing problems that satisfy the methodology assumptions and permits a rapid evaluation of the effects of parameter changes on attenuation. (Author's abstract)
W88-04459

SEPARATED FLOW IN LEE OF SOLID AND POROUS FENCES,
M.B.M. Coll. of Engineering, Jodhpur (India).
For primary bibliographic entry see Field 8B.
W88-04463

IMPORTANCE FOR BIRDS OF THE RIPARIAN WOODLANDS WITHIN THE ALLUVIAL CORRIDOR OF THE RIVER GARONNE, S.W. FRANCE,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2H.
W88-04474

RIVER REGULATION IN SPAIN,
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Montes. D. G. De Jalon.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 4, p 343-348, December 1987. 2 fig, 11 ref.

Descriptors: *River regulation, *Spain, River flow, Reservoirs, Water resources management, Regulations, Water supply.

In 1982 at the 2nd International Symposium on Regulated Streams held in Oslo, a review was presented dealing with the effects of flow-regulation structures on fluvial systems in Spain. Despite the large number of water regulation systems built in Spain, only three case-studies of their effects were reported. Two of these dealt with water supply reservoirs: the effects of the Susqueda reservoir on the aquatic insects of River Ter and the impacts caused by the Pinilla reservoir on the benthic communities of the Lozoya River. A third case, dealing with the effects of high altitude irrigation reservoirs of the Duero Basin on the fisheries and macroinvertebrates living in these fluvial systems, was also reported. The expansion of river regulation and of scientific research associated with river regulation in Spain since 1982, are the focus of this brief study. (Lantz-PTT)
W88-04477

2F. Groundwater

SURVIVAL AND TRANSPORT OF HEPATITIS A VIRUS IN SOILS, GROUNDWATER AND WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W88-03570

DISINFECTION OF CHLORINE RESISTENT ENTEROVIRUSES IN GROUND WATER BY ULTRAVIOLET IRRADIATION,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5B.
W88-03572

UNDERGROUND STORAGE TANKS POTENTIAL FOR ECONOMIC DISASTER,
Law Environmental Services, Marietta, GA.
For primary bibliographic entry see Field 5B.
W88-03610

THEORY OF SOLUTE TRANSPORT BY GROUNDWATER,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
For primary bibliographic entry see Field 5B.
W88-03685

GROUND WATER QUALITY MONITORING: THE ARKANSAS APPROACH,
Arkansas Dept. of Pollution Control and Ecology, Little Rock.
For primary bibliographic entry see Field 7B.
W88-03757

MULTIPLE-PACKER/STANDPIPE SYSTEM FOR GROUND WATER MONITORING IN CONSOLIDATED MEDIA,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 7B.
W88-03759

OBSERVATION OF DELIVERY AND SIMPLE QUALITY PARAMETERS ON SPRINGS OF THE FIRST VIENNA ELEVATED-SOURCE WATER SUPPLY,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
For primary bibliographic entry see Field 5F.
W88-03761

DEVELOPMENT OF A NATIONAL GROUNDWATER DATA BASE,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
J. Kirchner, J. W. Morris, and V. E. Cogho.
Water S. A. WASADV, Vol. 13, No. 3, p 165-170, July 1987. 4 fig, 1 tab, 6 ref.

Descriptors: *Groundwater, *Data bases, *Data processing, Geohydrology, Computers, Computer programs, South Africa.

A national groundwater data base was developed for the Orange Free State, South Africa. More than 200 different parameters per site can be stored in 33 data sets. Communication is interactive through terminals via the Transparent Government Network or telephone-line dial-up. Software was developed for data processing on the mainframe. Special geohydrological processing is done on IBM-compatible microcomputers for which programs have also been written. The system is explained and examples of the processed data are given. (Author's abstract)
W88-03771

MODELLING SEA-WATER INTRUSION IN THE ATLANTIS AQUIFER,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
J. L. Muller, J. F. Botha, and G. J. van Tonder.
Water S. A. WASADV, Vol. 13, No. 3, p 171-174, July 1987. 5 fig, 8 ref.

Descriptors: *Saline water intrusion, *Groundwater movement, *Pumpage, *Atlantis aquifer, *Model studies, *Groundwater, Bedrock, Springs, Aquifers, Saline water, Abstraction, Orange Free State, South Africa.

The phenomenon of sea-water intrusion in the Atlantis aquifer was studied by means of a vertical two-dimensional numerical model, based on density-dependent transport in a porous medium. To apply the model it was necessary to assume that the aquifer can be approximated by a hypothetical aquifer of constant depth, taken as the depth to bedrock at the Silwerstroom spring. Such a model is likely to over-estimate the distance of intrusion in the actual aquifer. It is, therefore, encouraging to find that, if the abstraction in the vicinity of the Silwerstroom spring is kept to a rate below 4,120,000 cu m/a, the possibility of sea-water intrusion is small. (Author's abstract)
W88-03772

AQUAMOD: A Z-DIMENSIONAL GALERKIN FINITE-ELEMENT SIMULATION PROGRAM FOR MICROCOMPUTERS FOR PREDICTION OF POLLUTANT TRANSPORT IN SATURATED GROUNDWATER FLOW (AQUAMOD: 'N TWEE-DIMENSIONELE GALERKIN EINDIGE ELEMENT SIMULASIEPROGRAM VIR MIKROEKENAARS VIR DIE VOORSPELLING VAN VERSADIGDE GRONDWATERVLOEI EN BESOEDELING),
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
G. J. van Tonder, and V. E. Cogho.
Water S. A. WASADV, Vol. 13, No. 3, p 175-180, July 1987. 7 fig, 4 ref.

Descriptors: *Microcomputers, *AQUAMOD, *Computer programs, *Groundwater movement, *Path of pollutants, *Model studies, *Simulation, Computers, Solute transport, Equations, Pressure.

AQUAMOD is a computer program which simulates groundwater movement and transport of dissolved substances in a saturated subsurface environment using a micro-computer. The program employs a two-dimensional Galerkin finite-element method to approximate the governing equations that describe the two processes which are simulated by AQUAMOD. AQUAMOD is primarily intended for two-dimensional simulation of flow and solute transport in saturated systems, and provides fluid pressures and solute concentrations, as they vary with time, everywhere in the simulated aquifer system. AQUAMOD runs on an IBM compatible micro-computer with a 520 K memory. (Author's abstract)
W88-03773

IMPROVING TUBEWELL IRRIGATION SYSTEM PERFORMANCE,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 3F.
W88-03782

SELECTED PAPERS IN THE HYDROLOGIC SCIENCES, 1985.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W88-03884

PRELIMINARY MODELING OF A DOUBLET-WELL SYSTEM FOR AQUIFER THERMAL-ENERGY STORAGE,
Geological Survey, St. Paul, MN. Water Resources Div.
R. T. Miller.
In: USGS Water-Supply Paper 2270, 198. p 1-20, 18 fig, 2 tab, 13 ref.

Descriptors: *Energy budget, *Aquifer, *Thermal energy storage, *Mathematical models, *Minnesota, *Franconia-Ironton-Galesville sandstone aquifer, Convection, Groundwater movement.

The University of Minnesota, the Minnesota Geological Survey, and the U.S. Geological Survey (USGS) are studying the feasibility of storing water at a temperature of 150 C in the Franconia-Ironton-Galesville aquifer. The Aquifer Thermal-Energy Storage (ATES) project has a doublet-well design with a well spacing of approximately 250 meters. One well will be used for cool-water supply and the other well for hot-water injection. The USGS is constructing a model of groundwater flow and thermal-energy transport to aid in determining the efficiency of the ATES system. A preliminary model of radial flow and thermal-energy transport was constructed, based on hydraulic and thermal properties of the Franconia-Ironton-Galesville aquifer determined in previous studies. The model was used to investigate the sensitivity of model results to various hydraulic and thermal properties, to study the potential for buoyancy flow within the aquifer, and to study the effects of various injection/withdrawal rates and duration on thermal efficiency of the aquifer. (See also W88-03884) (USGS)
W88-03885

THREE-DIMENSIONAL SIMULATION OF FREE-SURFACE AQUIFERS BY FINITE-ELEMENT METHOD,
Geological Survey, Sacramento, CA. Water Resources Div.
T. J. Durbin, and C. Berenbrock.
In: USGS Water-Supply Paper 2270, 1985. p 51-68, 12 fig, 1 tab, 16 ref.

Descriptors: *Groundwater, *Finite-element methods, *Groundwater movement, Model studies, Algorithms, Free surfaces, Aquifers, Tetrahedral elements, Triangular elements.

An iterative finite-element algorithm has been developed for the simulation of three-dimensional free-surface aquifers. The Galerkin finite-element method is applied to tetrahedral or triangular elements for volume or surface integrations. Integrations in time are by a fully implicit finite-difference representation. The algorithm solves the equation of groundwater flow subject to the free-surface boundary conditions as described by a linearized partial differential equation. To account for geometric changes in the flow domain resulting from movement of the free surface, the finite-element grid is deformed during transient-state simulation. The algorithm allows for local rotation of the hydraulic-conductivity tensor. (See also W88-03884) (USGS)
W88-03888

GROUNDWATER STORAGE DEPLETION IN PAHRUMP VALLEY, NEVADA-CALIFORNIA, 1962-75,
Geological Survey, Carson City, NV. Water Resources Div.
J. R. Harrill.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2279, 1986. 53 p, 24 fig, 8 tab, 46 ref.

Descriptors: *Groundwater, *Water supply, *Water wells, *Nevada, Overdraft, Pahrump Valley, Storage depletion.

During the 14-year period 1962-75 about 540,000 acre-feet of groundwater was pumped from Pahrump Valley. This pumping resulted in 219,000 acre-feet of groundwater storage depletion. Of this, 155,000 acre-feet was from draining of unconsolidated material, 46,000 was from compaction of fine-grained sediments, and 18,000 acre-feet was from the elastic response of the aquifer and water. Total storage depletion was equal to 40% of the total pumpage. The remaining pumpage was derived from capture of natural groundwater discharge and reuse of pumped water recirculated back to groundwater. Natural recharge to and discharge from the groundwater system is estimated to be 37,000 acre-feet/yr. Of this, 18,000 acre-feet/yr leaves the area as subsurface outflow through carbonate-rock aquifers which form a multivalley flow system. The extent of this system was not precisely determined by this study. The most probable discharge area for this outflow is along the flood plain of the Amargosa River between the towns of Shoshone and Tecopa. This outflow probably cannot be economically captured by pumping from Pahrump Valley. Consequently the maximum amount of natural discharge available for capture is 19,000 acre-ft/yr. This is larger than the 12,000 acre-ft/yr estimated, the difference is due to different techniques used in the analysis. As of 1975, pumping was causing an overdraft of 11,000 acre-feet/yr on the groundwater system. Water levels will probably continue to slowly decline until the pumping is reduced. The moderate rates of decline and very large amounts of groundwater stored in the valley-fill reservoir suggest that a long time will be required before the valley-wide depletion of groundwater storage becomes critical. Problems involving water quality, land subsidence, and well interference will probably occur first. (USGS)
W88-03898

SUBSURFACE INJECTION OF LIQUID WASTE WITH EMPHASIS ON FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W88-03900

APPLICATION OF A PARAMETER-ESTIMATION TECHNIQUE TO THE REGIONAL AQUIFER UNDERLYING THE EASTERN SNAKE RIVER PLAIN, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
S. P. Garabedian.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2278, 1986. 60 p, 15 fig, 13 tab, 23 ref.

Descriptors: *Groundwater, *Statistical analyses, *Groundwater movement, *Snake River Plain, *Idaho, Model studies, Regression analysis, Regional aquifers, Regional Aquifer-System Analysis.

A nonlinear, least-squares regression technique for the estimation of groundwater flow model parameters was applied to the regional aquifer underlying the eastern Snake River Plain, Idaho. The computer program is based on a technique for two-dimensional, steady-state groundwater flow. Hydrologic data for the 1980 water year were used to calculate recharge rates, boundary fluxes, and spring discharges. Groundwater use was estimated from irrigated land maps and crop consumptive-use figures. These mass-flux estimates, along with leakance, were used as known values in model calibration of transmissivity. Leakance values were adjusted between model simulations by comparing model-calculated to measured spring discharges. Results indicate a wide range in transmissivity from about 0.05 to 44 sq ft/sec and in leakance from about 2.2 x 10 to the -9 power to 6.0 x 10 to the -8 power feet/sec/foot. Along with parameter values, model statistics were calculated, including the correlation coefficient (0.996), model standard error (40 feet), and parameter standard errors (about 10-40%). The model was most sensitive to changes in recharge, and in some areas, to changes in transmissivity, particularly near the spring discharge area from Milner to King Hill. (USGS)
W88-03902

GEOHYDROLOGY OF THE BASALT AND UNCONSOLIDATED SEDIMENTARY AQUIFERS IN THE FALLON AREA, CHURCHILL COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
P. A. Glancy.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2263, 1986. 62 p, 26 fig, 12 tab, 25 ref.

Descriptors: *Alluvial aquifers, *Geohydrology, *Water chemistry, *Radioisotopes, *Nevada, Transmissivity, Groundwater recharge, Specific capacity, Storage coefficient, Potentiometric levels, Aquifer characteristics, Radioactive dating, Stable isotopes, Confined aquifers, Hydraulic conductivity, Basalt aquifers, Fallon, Carson Desert, Carson River, Truckee Canal.

Aquifers near Fallon, Nevada belong to a large interdependent system that can be hydrologically subdivided into four subsystems. In decreasing order of present use, they are: A hydraulically and chemically complex shallow alluvial aquifer; a highly permeable deeper basalt aquifer of near-homogeneous, moderately fresh chemical character; an intermediate-depth alluvial aquifer, locally containing large quantities of freshwater; and a deep, probably saline-water bearing alluvial aquifer. The basalt aquifer, according to geophysical data, appears to be mushroom shaped. It is recharged mainly by freshwater from overlying alluvial aquifers combined with a blend of saline water from underlying alluvium. Heaviest pumped areas of basalt contain chemical evidence of modern (post-1953) recharge. Basalt recharge before the onset of pumping was about 2,500 acre-feet annually and is now supplemented by pumpage-induced recharge proportionate to pumpage rates. The artesian basalt aquifer exhibits a nearly flat potentiometric gradient throughout its nearly 10-mi length. The shallow alluvial aquifer contains mostly hard water, in contrast to the soft water of other aquifers. All aquifers contain water having dissolved arsenic in concentrations greater than allowable health limits. The arsenic is probably derived from the upper part of the valley-fill sediments. Groundwater flows through the several aquifers toward sink-discharge areas of the Carson Desert. (USGS)
W88-03903

HYDROLOGY OF THE PRICE RIVER BASIN, UTAH, WITH EMPHASIS ON SELECTED COAL-FIELD AREAS,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. M. Waddell, J. E. Dodge, D. W. Darby, and S. M. Theobald.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2246, 1986. 51 p, 27 fig, 11 tab, 30 ref.

Descriptors: *Utah, *Hydrologic budget, *Price River basin, Colorado River basin, Hydrology, Hydrologic data, Surface water, Groundwater, Water quality, Carbon County, Wasatch Plateau, Book Cliffs, Coal mines.

Data obtained during a hydrologic study of the Price River basin, Utah, are used to describe seasonal variations of flow of springs, relationships between groundwater and surface water, hydraulic properties of the groundwater reservoir, groundwater recharge and discharge, flood characteristics of streams, mineralogic composition and depositional rates of sediment, nutrient and organic loading in streams and in Scofield Reservoir, and water budgets for selected basins. Additional study and monitoring are needed to detect possible hydrologic changes resulting from coal mining. The potentiometric surface of water in the Blackshaw Formation in the Wasatch Plateau (Mud Creek drainage) and the Book Cliffs (Soldier Creek area) generally is above the coal zones, and dewatering will be necessary in most places during mining. The total reported mine discharge during 1980 was about 2,800 acre-feet. During the 1980 water year, groundwater discharge from the Flagstaff Limestone contributed about 4,400 acre-feet, or 41% of the combined streamflow of Coal, Soldier, and Dugout Creeks. Discharge from the Blackhawk and other formations contributed about 2,200 acre-feet, of 21% or the streamflow. The recharge to a 4,020-acre outcrop of the Flagstaff Limestone in the Solider Creek area was determined from measurements of the discharge of springs and seepage gains in streams. The estimated recharge was 2 inches/yr, or 12% of the April 1 snowpack, or 9% of the precipitation during 1980. Benthic-diversity indexes at streams in the Book Cliffs and Wasatch Plateau are relatived to the size of the bed material. The Shannon-Weiner diversity index for five sites in the Mud Creek drainage ranged from 1.57 to 4.20 during four sampling periods in 1979-80. In the Soldier Creek drainage, the diversity index for four sampling sites ranged from 0.8 to 2.3 during three sampling periods in 1979-80. Sediment deposition in Scofield Reservoir during 1943-79 was estimated to be 3,000 acre-ft but most of the coal deposition in the reservoir occurred prior to about 1950. An anaerobic zone develops in the reservoir during the summer, but water in the reservoir completely mixes during late summer or early fall. (USGS)
W88-03904

GEOHYDROLOGY OF BEDROCK AQUIFERS OF THE NORTHERN GREAT PLAINS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,
Geological Survey, Denver, CO. Water Resources Div.
J. S. Downey.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Professional Paper 1402E, 1986. 87 p, 72 fig, 2 tab, 179 ref.

Descriptors: *Geohydrology, *Aquifer systems, *Sedimentary rocks, *Groundwater movement, *Flow systems, Geology, Simulation models, Geochemistry, Paleozoic aquifers, Mesozoic aquifers, Madison limestone, Dakota aquifer, Montana, North Dakota, South Dakota, Wyoming, Northern Great Plains.

Rocks of Paleozoic and Mesozoic age underlie the entire northern Great Plains of the United States. These rocks form 5 artesian aquifer systems that are recharged in the mountainous areas of Montana, South Dakota, and Wyoming and extend more than 600 miles to discharge areas in the northeastern part of North Dakota and in the Canadian Province of Manitoba. Generally, the principal direction of flow in each aquifer is deflected to the north and south around the Williston basin. Flow through the Williston basin is restricted because of geologic structure, and decreased permeability of rocks in the deeper parts of the basin. Major fracture systems or lineaments traverse the geologic section and are either vertical or horizontal conduits, or barriers to, groundwater flow. Vertical leakage from the aquifers is restricted by shale of minimal permeability, halite beds, and stratigraphic traps or minimal-permeability zones associated with petroleum accumulations. Interaquifer leakage appears to occur through and along some of the major lineaments. During the Pleistocene Epoch, thick ice sheets completely covered the discharge areas of the bedrock aquifers. This effectively blocked flow northeastward from the system and, at some locations, it may have caused a reversal of flow. The existing flow, system therefore, may not have reached hydrologic equilibrium with the stress of the last glacial period. (USGS)
W88-03907

GROUNDWATER HYDROLOGY AND SUBSURFACE MIGRATION OF RADIONUCLIDES AT A COMMERCIAL RADIOACTIVE-WASTE BURIAL SITE, WEST VALLEY, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03909

NATIONAL WATER SUMMARY 1984--HYDROLOGIC EVENTS, SELECTED WATER-QUALITY TRENDS, AND GROUNDWATER RESOURCES.
Geological Survey, Reston, VA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-185062/AS. Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Supply Paper 2275, 1985. 467 p, 287 fig, 123 tab.

Descriptors: *National water summary, *Hydrologic events (annual), *Water quality, *Groundwater resources, *Aquifer characteristics, *State groundwater maps, *Seasonal summaries, Aquifers, Water wells, Dissolved solids, Sediment deposition, Lake levels, Floods, Suspended sediments, Nitrates, Phosphorus, Inorganic nitrogen.

The first part of this second National Summary provides a synopsis of the hydrologic conditions and water-related events that occurred during the 1984 water year (October 1, 1983-September 30, 1984). Streamflow variations are compared to precipitation, temperature, and upper-air atmospheric pressure for the four seasonal quarters of the year to relate surface-water flows to climatic conditions. The second part contains two sections. In the section titled 'Water-Quality Issues', the occurrence of sediment, dissolved solids, nutrients, and pesticides in the Nation's streams are discussed. Recently compiled information is used to show the distribution and trends of these constituents and to relate them to various natural sources and human activities. The occurrence and sources of nitrate in groundwater also are discussed. The section entitled 'Water-Availability Issue' provides hydrologic explanations for changes in groundwater levels in several areas of the country. The third part summarizes for each state, and all U.S. territorial and trust possessions, the distribution, characteristics, and uses of principal aquifers. Each summary contains maps that show the location of aquifers and major areas of groundwater withdrawals and tables that describe the characteristics of the aquifers and present data on groundwater withdrawals. (USGS)
W88-03910

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BOZEMAN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03912

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, HARDIN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03913

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, WHITE SULPHUR SPRINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03914

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BILLINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03915

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, ROUNDUP 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03916

GROUNDWATER HYDROLOGY OF THE GUYANDOTTE RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03917

GROUNDWATER HYDROLOGY OF THE UPPER NEW RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03918

GROUNDWATER HYDROLOGY OF THE TUG FORK AND TWELVEPOLE CREEK BASINS, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03919

GROUNDWATER HYDROLOGY OF THE COAL RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03920

WATER IN HARDY, HAMPSHIRE, AND WESTERN MORGAN COUNTIES, WEST VIRGINIA,
Geological Survey, Morgantown, WV. Water Resources Div.
W. A. Hobba.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Environmental Geology Bulletin EGB-19, 1985. 91 p, 20 fig, 15 tab, 17 ref.

Descriptors: *Groundwater, *Specific capacity, *Transmissivity, *Water quality, *West Virginia, Surface-groundwater relationships, Fractures, Chemical analyses, Potomac River basin, Valley and Ridge Physiographic province.

Emphasis is given to the effect that fractured sedimentary consolidated aquifers have on groundwater and surface-water hydrology and chemistry. Fracture traces, faults, and lineaments were mapped from aerial photographs, satellite imagery, and in the field. Quantity and quality data were collected at 685 wells, 100 springs, 4 regular gaging stations, and 19 other small stream sites. Surface-water and groundwater relationships are discussed and illustrated. Sixty-two selected wells were tested for drawdown and recovery, and the water sampled. Transmissivity values determined from single-well recovery tests and channel methods ranged from 0.6 sq ft/day for shale and siltstone to 627 sq ft/day for limestone. Statistical analysis shows that wells yielding the most water are in fractures or in valleys. Wells yielding the least are in nonfractured areas or in hillsides or hilltops. Statistically, specific conductance varies from one aquifer to another, and is higher in water from valley wells than in water from hillside or hilltop wells. Sulfate concentrations are higher in water from wells in fractures or in valleys than in water from wells in nonfractured areas. Maps show that specific conductance of groundwater ranges from 18 to 7,600 micromhos, hardness ranges from 3 to 6,370 mg/L, chloride ranges from 1 to 1,270 mg/L sulfate ranges from 0 to 5,980 mg/L, iron ranges from 0 to 18,000 micrograms/L and pH from 4 to 9. (USGS)
W88-03921

GROUNDWATER HYDROLOGY OF THE MONONGAHELA RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03922

SEEPAGE STUDY OF SIX CANALS IN SALT LAKE COUNTY, UTAH, 1982-83,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4A.
W88-03923

GROUNDWATER CONDITIONS IN THE LAKE POWELL AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
P. J. Blanchard.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Utah Department of Natural Resources and Energy, Salt Lake City, Technical Publication 84, 1986. 64 p, 14 fig, 9 tab, 29 ref.

Descriptors: *Aquifers, *Aquifer characteristics, *Groundwater quality, *Water yield, *Navajo Sandstone, *Utah, Sandstones, Springs, Surface-groundwater relationships, Trace elements, Radioisotopes, Lake Powell, Upper Colorado River Basin, San Juan River Basin.

The Lake Powell area covers about 2,440 sq mi in south-central Utah. It is divided into three areas geographically by the Colorado and San Juan Rivers--the Henry Mountains area north of the Colorado River, the Navajo Mountain area south of the San Juan River, and the area between the Colorado and San Juan Rivers. The Entrada, Navajo, and Wingate Sandstones are the principal aquifers in the Lake Powell area, and the Navajo Sandstone is the most significant of the three formations. Recharge to the aquifers occurs by direct infiltration of precipitation and by infiltration of water stored in dune sand where it overlies the aquifers. In the Henry Mountains area, recharge also occurs by downward movement of water from overlying formations on the flanks of the Henry Mountains, where those formations are strongly fractured. Discharge from the Glen Canyon Group (the Navajo Sandstone, the Kayenta Formation, and the Wingate Sandstone) generally occurs via small springs and seeps, which generally discharge less than 10 gallons/min to Glen Canyon, the canyon of the San Juan River, and to the tributary canyons near their mouths. Annual discharge is about 1,000 acre-feet in the Henry Mountains area, about 1,000 acre-feet in the area between the Colorado and San Juan Rivers, and about 1,500 acre-feet in the Navajo Mountain area. Because of the small amount of recharge to and discharge from the Glen Canyon Group, large withdrawals of water, such as those required for large energy production stations, would result in decreased water in storage. Groundwater throughout the Lake Powell area is fresh. The chemical type of water is mixed, with calcium, magnesium, and bicarbonate commonly present in significant concentrations. In the Henry Mountains area, sodium is also present in significant concentrations. Concentrations of radionuclides are larger in the Henry Mountains area than in the area between the Colorado and San Juan Rivers, most likely due to the presence and/or development of the uranium-rich Salt Wash Member of the Morrison Formation. (USGS)
W88-03924

GROUNDWATER CONDITIONS IN THE KAIPAROWITS PLATEAU AREA, UTAH AND ARIZONA, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
P. J. Blanchard.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Utah Department of Natural Resources, Salt Lake City, Technical Publication 81, 1986. 87 p, 17 fig, 16 tab, 32 ref.

Descriptors: *Aquifers, *Aquifer characteristics, *Surface-groundwater relationships, *Utah, *Arizona, Bank storage, Groundwater, Sandstones, Springs, Trace elements, Navajo Sandstone, Coconino County, Garfield County, Kan County, Escalante River basin, Paria River basin, Kaiparowits Plateau.

Groundwater conditions are described for the Kaiparowits area, in central Garfield and eastern Kane Counties of southern Utah and Coconino County of northern Arizona. The area covers about 4,850 sq mi and includes drainage basins of the Escalante and Paria Rivers and drainages to the Colorado River between the Escalante and Paria Rivers. The most important consolidated rock aquifer in the area is the Navajo Sandstone of Triassic and Jurassic age. The Entrada Sandstone of Jurassic age is a secondary aquifer, and the Wingate Sandstone of Triassic age presently is not developed but potentially is a significant aquifer. Depth to the top of the Navajo Sandstone ranges from the surface near Boulder, Utah, on the Paria Plateau, west of the Kaiparowits Plateau, and in canyons of the Escalante and Paria Rivers, to as much as 4,500 feet in the center of the Kaiparowits Plateau. Saturated thickness ranges from 0 in the Paria Plateau area to about 1,900 ft near the intersection of U.S. Highway 89 and the Paria River. Chemical quality of water in the Navajo Sandstone is generally fresh (<1,000 milligrams/L dissolved solids). In areas where the aquifer is confined, near the intersection of U.S. Highway 89 and the Paria River and near the parts of the Lake Powell shoreline, water from the Navajo is generally slightly saline (1,000-3,000 milligrams/L dissolved solids). Annual recharge to and discharge from the Navajo Sandstone in the study area is estimated to be between 8,300 and 16,900 acre-feet. Large increases in use of Navajo Sandstone water would require removing water from storage rather than from diversion of natural discharges. (USGS)
W88-03925

SINKHOLE FEATURES OF FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03927

WATER IN THE UPPER YAKIMA RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W88-03929

WATER IN THE LOWER YAKIMA RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W88-03930

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CUT BANK 1-DEGREE BY 2-DEGREE QUADRANGLE,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03945

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CHOTEAU 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03946

HYDROLOGIC TESTING METHODOLOGY AND RESULTS FROM DEEP BASALT BOREHOLES,
Atomics International Div., Richland, WA. Energy Systems Group.
S. R. Strait, F. A. Spane, R. L. Jackson, and W. W. Pidcoe.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-014092. Price codes: A02 in paper copy, A01 in microfiche. RHO-BW-SA-189, May 1982. 23 p, 17 fig. Contract No. DE-AC06-77RL01030.

Descriptors: *Groundwater, *Hydraulic properties, *Aquifer testing, Radioactive waste disposal, Groundwater movement, Basalt Waste Isolation Project, Columbia River, Hanford Site, Washington, Baseline studies, Spatial variation, Boreholes, Hydraulic conductivity, Storativity, Transmissivity, Packers.

Hydrological studies were conducted in the Columbia River basin as part of the Basalt Waste Isolation Project. The effort was directed toward characterizing the areal and vertical distributions of hydraulic head, hydraulic properties, and hydrochemistry. Equipment and methods used (the downhole packer system and surface recording equipment) were described. Hydraulic conductivity and storativity were reported for several locations. (Cassar-PTT)
W88-03991

EXPERIMENTAL AND NUMERICAL ANALYSES OF PERCHED GROUNDWATER MOUNDS BELOW SEPTIC SYSTEMS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W88-04037

HYDROGEOLOGIC CHARACTERISTICS OF THE RAMAPO FAULT, NORTHERN NEW JERSEY,
Chen and Associates, Denver, CO.
D. R. Ganser.
Ground Water GRWAAR, Vol. 25, No. 6, p 664-671, November-December, 1987. 8 fig, 1 tab, 15 ref.

Descriptors: *Geologic fractures, *Geohydrology, *Ramapo Fault, *New Jersey, *Groundwater recharge, Aquifers, Groundwater supply, Mapping, Geology, Permeability coefficient, Recharge.

The Ramapo Fault is a major structural feature of northern New Jersey separating the Triassic-age Newark Basin from the Precambrian Reading Prong. When the New Jersey Department of Transportation proposed extending Interstate Highway 287 north of Boonton, New Jersey, along the fault alignment, concerns were raised regarding the potential for the fault to act as a preferential source of groundwater recharge to aquifers supplying domestic and industrial needs. It was feared that highway contaminants and spills could infiltrate the fault zone, be transported along the fault, and recharge the unconsolidated Pleistocene-age buried valley aquifers, principally the Towaco Valley aquifer. As a result of these concerns, a detailed investigation was performed to determine the location and hydrogeologic character of the fault. Geologic mapping and geophysical techniques were employed to locate the fault prior to core drilling and packer testing of the fault. Geophysical logs were obtained from the borings to assist in characterization of the formation properties and to verify the fault location. The results of the investigation indicate that the Ramapo Fault has a calculated hydraulic conductivity of less than 0.0000001 cm/sec which was indistinguishable from the surrounding formations. It was concluded that the Ramapo Fault does not provide groundwater recharge to the unconsolidated buried valley aquifers within the study area. The deltaic deposits overlying bedrock directly upgradient of the buried valley exhibited relatively high hydraulic conductivity (0.01 cm/sec) providing the major source of recharge to the unconsolidated aquifers in the Towaco Valley. (Author's abstract)
W88-04057

APPLICATIONS OF UNIVERSAL KRIGING TO AN AQUIFER STUDY IN NEW JERSEY,
Geological Survey, Trenton, NJ.
A. A. Pucci, and J. E. Murashige.
Ground Water GRWAAR, Vol. 25, No. 6, p 672-678, November-December 1987. 5 fig, 1 tab, 11 ref.

Descriptors: *Kriging, *Statistical methods, *Data acquisition, *Aquifers, *New Jersey, Groundwater, Permeability coefficient, Mathematical studies, Mathematical equations, Aquifer characteristics, Aquifer testing.

The use of kriging for optimizing data collection and utility in a regional groundwater investigation of the Potomac-Raritan-Magothy aquifer system in central New Jersey is described. Kriging was used to: (1) estimate the altitude of an aquifer surface, (2) estimate hydraulic conductivities from point data, and (3) estimate the associated kriged errors. The selection of locations for additional data collection, based on the kriged errors, was effective in terms of improving the aquifer surface data base. In another application, hydraulic conductivity values were kriged, first using equal weights, then unequal weights to account for the reliability of the data. The weighting values that were used for unequal weighting were estimated by an analysis of variance. Although inclusion of the data reliability in the kriging will increase the kriged errors, the accuracy of the range of uncertainty in the interpolated values also increases. (Author's abstract)
W88-04058

METHODS OF DETERMINING SPECIFIC YIELD,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Ground Water GRWAAR, Vol. 25, No. 6, p 679-684, November-December 1987. 3 tab, 14 ref.

Descriptors: *Groundwater potential, *Specific yield, *Groundwater management, *Groundwater budget, Hydrologic budgets, Aquifers, Groundwater level.

A comparative discussion of several methods for the determination of specific yield is presented. The discussion relies on a pumping test conducted recently by Nwankwor and coworkers from the University of Waterloo in an unconfined aquifer at Borden, Ontario, Canada. The authors show that a water-balance method promulgated by these workers and used earlier by others, including Wenzel in 1942 and 1946, is invalid because it overlooks a major component of the water budget. This method suggests erroneously that specific yield increases with time during a pumping test. The method can therefore lead to arbitrarily large specific yield values which may lack physical significance. By relying on this water-balance method and on laboratory drainage experiments, Nwankwor and coworkers conclude incorrectly that type-curve methods, such as those proposed by Prickett in 1965 and Neuman in 1975, give unreasonably low specific yield values. The authors also show that these specific yield values are consistent with water-balance considerations when all the components of the water budget are properly taken into account. The authors further point out that whereas the larger specific yields usually obtained from laboratory drainage experiments may be well suited for the evaluation of groundwater reserves that can potentially be recovered from an unconfined aquifer over long periods of time, they are not directly relevant to the problem of relating groundwater level variations to pumpage which is characterized by a shorter time scale. This is especially true when specific yield is taken to be the difference between water content at saturation and residual water content at high suctions as done by Nwankwor and coworkers. The rate at which groundwater levels drop or fluctuate in response to pumpage is controlled by the smaller specific yield that one obtains from time-drawdown analyses. (Author's abstract)
W88-04059

EXAMPLES OF TRANSIENT SOUNDING FOR GROUND-WATER EXPLORATION IN SEDIMENTARY AQUIFERS,
Geological Survey, Denver, CO.
D. V. Fitterman.
Ground Water GRWAAR, Vol. 25, No. 6, p 685-692, November-December 1987. 8 fig, 21 ref.

Descriptors: *Aquifers, *Beophysics, *Electromagnetic studies, *Groundwater potential, *Exploration, Glacial aquifers, Resistivity, Aquifer characteristics.

Examples of the use of transient electromagnetic soundings for three groundwater exploration problems in sedimentary aquifers are given. The examples include: (1) estimating depths to water table and bedrock in an alluvium-filled basin, (2) mapping a confined fresh water aquifer in bedrock sediments, and (3) locating a fresh water/salt water interface in a glacial-outwash aquifer. The technique works quite well for these problems within the limitations imposed by the problem of equivalence. For thin conductive targets (S-equivalence) such as a salt water lens, the ratio of the layer thickness to its resistivity can be determined, but not the individual layer parameters. The thickness of thin resistive zones (H-equivalence) can be resolved, but the resistivity of such layers is not well determined. The problem of H-equivalence is more severe than the S-equivalence. Equivalence imposes restrictions on the transient sounding method for some groundwater exploration problems. Model studies prior to field work can be used to assess the usefulness of the technique for a particular exploration objective. (Author's abstract)
W88-04060

DBCP, EDB, AND TCP CONTAMINATION OF GROUND WATER IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W88-04061

SEISMIC REFLECTION STUDY OF A SHALLOW AQUIFER DURING A PUMPING TEST,
Kansas State Geological Survey, Lawrence.
B. A. Birkelo, D. W. Steeples, R. D. Miller, and M. Sophocleous.
Ground Water GRWAAR, Vol. 25, No. 6, p 703-709, November-December 1987. 11 fig, 1 tab, 10 ref.

Descriptors: *Shallow aquifers, *Pumping tests, *Geophysics, *Seismic reflection, Aquifers,

Groundwater potential, Sounding, Drawdown, Groudwater movement.

Seismic reflection surveys were used to follow the drawdown in a shallow aquifer during a pumping test. Using severe analog low-cut filters and 1/4-m geophone spacings, 335 Hz reflections were obtained from the top of the saturated zone 2.7 m deep. The reflections moved down in time as the saturated zone dropped in response to pumping. The dominant frequency and bandwidth both dropped during pumping indicating a more diffuse reflecting boundary. Slight pullups of reflectors at specific locations on the (common depth point) CDP sections may indicate a higher elevation of the capillary fringe and therefore finer sediments in those locations. Other potential applications of this technique include mapping cones of depression and detecting and delineating perched-water tables. (Author's abstract)
W88-04062

THEIS' SOLUTION BY NONLINEAR LEAST-SQUARES AND FINITE-DIFFERENCE NEWTON'S METHOD,
National Chiao Tung Univ., Hsinchu (Taiwan). Dept. of Civil Engineering.
H. D. Yeh.
Ground Water GRWAAR, Vol. 25, No. 6, p 710-715, November-December 1987. 5 tab, 24 ref.

Descriptors: *Theis method, *Pumping tests, *Least squares method, *Finite difference method, *Mathematical studies, *Aquifer characteristics, Homogeneity, Groundwater, Aquifer systems, Transmissivity, Mathematical equations, Aquifer testing.

A method using the nonlinear least-squares and finite-difference Newton's method was applied to determine the aquifer parameters via a pumping test in a homogeneous and isotropic confined aquifer system. The nonlinear least-squares was used to find the values of transmissivity and storage coefficient such that the sum of the squares of differences between the predicted drawdowns and observed drawdowns is minimized. The finite-difference Newton's method was used to solve the system of nonlinear least-squares equations for transmissivity and storage coefficient. Comparisons of the results between the proposed method and graphical methods including the Theis, Cooper-Jacob, and Chow methods are discussed in detail, showing data of a 6-hour pumping test. The proposed method has the advantages of high accuracy and quick convergence for most initial guesses. (Author's abstract)
W88-04063

ANALYSIS OF HILLSIDE SEEPAGE,
Auburn Univ., AL. Dept. of Civil Engineering.
J. G. Melville, and P. N. Sims.
Ground Water GRWAAR, Vol. 25, No. 6, p 716-721, November-December 1987. 8 fig, 8 ref, append.

Descriptors: *Seepage, *Hillside seepage, *Mathematical analysis, *Groundwater recharge, Surface-groundwater relations, Mathematical studies.

A steady-state hillside seepage problem was solved analytically. Subject to the Dupuit-Forchheimer assumption, one-dimensional seepage with uniform recharge over an inclined impervious bed was analyzed. Results are presented graphically showing the profile dependence on a single parameter. The different character of the solutions is shown. Special properties of the solutions, the location and value of the maximum depth and the minimum initial depth, were analyzed. Profiles for the finite-length aquifer were also calculated numerically. These profiles, generated using a Runge-Kutta approximation of the differential equation, cannot be compressed into one family of curves, but they do provide an improved physical view of the depth variation. (Lantz-PTT)
W88-04064

SEEPAGE FACE SIMULATION USING PLASM,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
S. T. Potter, and W. J. Gburek.
Ground Water GRWAAR, Vol. 25, No. 6, p 722-732, November-December 1987. 10 fig, 1 tab, 18 ref.

Descriptors: *Seepage, *PLASM, *Simulation analysis, *Groundwater movement, Computer models, Aquifers, Groundwater recharge, Mathematical studies.

An unconfined aquifer variation of the Prickett and Lonnquist Aquifer Simulation Model (PLASM) has been modified to simulate the dynamics of seepage face development and compute flow rates. The modifications, based on hydraulic theory and operating within the framework of the original model, enable the model to simulate zones of seepage contiguous and noncontiguous to streams, lakes, or other points of groundwater discharge. A simplistic overland flow routing procedure to move seepage flow downslope from points of discharge and permitting it to reenter where the water table is below the land surface was also incorporated. To determine the error associated with this discrete solution, the modified numerical model was compared to a series of analytically equivalent Dupuit-Forchheimer-based solutions. The numerical solutions from PLASM compare to the closed-form solutions to within the uncertainty of the models finite-difference discretization. The comparisons indicate that errors in seepage face prediction result strictly from PLASM's inclusion of the D-F approximations, not from the formulation of the numerical seepage face simulation routine. Finally, the modified PLASM was applied to a hypothetical watershed under dynamic conditions to demonstrate its capabilities. The unconfined aquifer version of PLASM works best in situations where both thickness-to-length ratio of the aquifer and land surface and water-table slopes are relatively small, geometry typical of many real-world watersheds. Under such conditions, the modifications developed are shown to logically and consistently simulate the extent, dynamics, and flow rates of seepage zones with minimum error. (Author's abstract)
W88-04065

HORIZONTAL PLANE SOURCE MODEL FOR GROUND-WATER TRANSPORT,
ERT, A Resource Engineering Co., Concord, MA.
For primary bibliographic entry see Field 5B.
W88-04066

VOC REMOVAL FROM GROUNDWATER - A CASE HISTORY,
Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, PA.
For primary bibliographic entry see Field 5G.
W88-04175

INTERACTING PRECIPITATION/DISSOLUTION WAVES: THE MOVEMENT OF INORGANIC CONTAMINANTS IN GROUNDWATER,
Texas Univ. at Austin. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W88-04185

LABORATORY INVESTIGATION OF LONGITUDINAL DISPERSION IN ANISOTROPIC POROUS MEDIA,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W88-04192

SUBSURFACE SEAWATER INTRUSION BARRIER ANALYSIS,
Miyazaki Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-04237

UNSTABLE FLOW IN LAYERED SOILS: A REVIEW,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5B.
W88-04240

EFFECTS OF IRRIGATION ON WATER QUALITY OF A SHALLOW UNCONFINED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 6G.
W88-04279

DETERMINATION OF AQUIFER TRANSMISSIVITY FROM EARTH TIDE ANALYSIS,
Geological Survey, Menlo Park, CA.
P. A. Hsieh, J. D. Bredehoeft, and J. M. Farr.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1824-1832, October 1987. 8 fig, 4 tab, 19 ref, 2 append.

Descriptors: *Groundwater movement, *Transmissivity, *Aquifers, *Tidal effects, *Mathematical equations, Water level, Artesian aquifers, Tides, Mathematical models, Mathematical studies, Pressure head, Wells, Storage coefficient, Case studies, California, Hydraulic properties.

The water level in an open well tapping an artesian aquifer responds to pressure head disturbances caused by an Earth tide dilation of the aquifer. Because a finite amount of time is needed for water to flow into and out of the well, there exists a phase shift (or time lag) between the tidal dilation of the aquifer and the water level response in the well. An analytical solution is derived that expresses the phase shift as a function of the aquifer transmissivity, storage coefficient, well radius, and the period of the harmonic disturbance. This solution is rather insensitive to the storage coefficient. Thus if the phase shift is known for a harmonic disturbance, the transmissivity can be calculated given a rough estimate of the storage coefficient. Theoretical analysis shows that a significant phase shift may be present even if the disturbance is slowly varying, as in the case of Earth tides. This opens the possibility of estimating aquifer transmissivity from water level records that show Earth tide fluctuations. A case study, using data from a site near Parkfield, California, is presented to illustrate application of the theory. Phase shifts of the O sub 1 (25.82-hour period) and M sub 2 (12.42-hour period) tidal constituents were chosen for analysis because they are free of systemic contamination by fluctuations in barometric pressure. A brief error analysis suggests that the computed O sub 1 phase shift is subject to a large uncertainty, while the computed M sub 2 phase shift is substantially more accurate. Based on an assumed storage coefficient range of 0.0001 to 0.000001, the estimated transmissivity range is 0.000008 to 0.00002 sq m/second. While hydraulic tests were not performed to validate these estimates, the range is consistent with the transmissivity value determined by other investigators from analysis of the water level response to an earthquake. (Author's abstract)
W88-04303

VARIABLE DENSITY FLOW AND SOLUTE TRANSPORT SIMULATION OF REGIONAL AQUIFERS CONTAINING A NARROW FRESHWATER-SALTWATER TRANSITION ZONE,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W88-04306

DAGAN MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: FOUNDATIONAL ASPECTS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and D. A. Barry.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1867-1875, October 1987. 1 fig, 30 ref,

append. NSF Grant ECE-8513726.

Descriptors: *Groundwater movement, *Solute transport, *Dagan model, *Mathematical models, *Data interpretation, *Path of pollutants, Tracers, Convection-dispersion equation, Mathematical equations, Mathematical studies, Model studies, Aquifers, Canada, Dispersion coefficient, Prediction.

The convection-dispersion equation (CDE) developed by Dagan (1984) to predict the ensemble-average concentration of a conservative solute in groundwater was used successfully to interpret recent tracer experiments in a sand aquifer at the Borden site in Canada. This successful application encouraged further investigation of the Dagan model with respect to its physical basis and predictive characteristics. It is shown that the Dagan model CDE can be derived through an extension of the cumulant expansion technique applied in previous studies to develop a mean CDE for solute transport in homogeneous porous media. This technique also leads directly to the mean CDE as an asymptotic (large time) limit, and to model dispersion coefficients derived in other studies. The Dagan CDE then is considered in detail; with conceptualization of the solute concentration, resident or flux, which the model may use in predictive applications. General mathematical expressions relating the two conceptualizations are derived for an arbitrary solute transport problem and are then applied to the Dagan model for point and prism source inputs. Finally, the Dagan model is interpreted physically using data from the recent tracer experiments at the Borden site. It is shown that model predictions of resident and flux concentrations are numerically indistinguishable on any time scale over which field solute concentration measurements typically are made. However, the model prediction of dispersion coefficients leads to dramatic differences in predicted plume behavior depending on whether finite time expressions or their asymptotic limits are used. According to the Dagan model, the asymptotic transverse dispersion coefficient cannot replace the time-dependent coefficient on any realistic time scale for solute movement at the Borden site. (Wood-PTT)
W88-04307

CONDITIONAL SIMULATIONS OF FLUID FLOW IN THREE-DIMENSIONAL NETWORKS OF DISCRETE FRACTURES,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
J. Andersson, and B. Dverstorp.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1876-1886, October 1987. 5 fig, 11 tab, 25 ref.

Descriptors: *Geologic fractures, *Geohydrology, *Fluid flow, *Fluid mechanics, *Groundwater movement, Prediction, Statistical analysis, Model studies, Mathematical models, Mathematical equations, Mathematical studies, Transmissivity, Simulation analysis, Monte Carlo method.

How to predict flow through a network of discrete fractures in a three-dimensional domain was investigated by modeling fractures as circular discs of arbitrary size, orientation, transmissivity, and location. A fracture network is characterized by the statistical distributions of these quantities. Fracture traces observed on a wall form the basis for estimates of mean fracture radius, fracture orientation parameters, and fracture density. Fracture trace lengths are estimated with the scanline method and from areal sampling on circular regions. The traces observed on the wall can also be used to condition the network. This trace conditioning is achieved by forcing the network generator to always reproduce the observed traces. Conditioning might be a means of decreasing the variability of the fracture networks. A numerical simulation model was developed which is capable of generating a fracture network of desired statistical properties and solving for the steady state flow. On each fracture disc the flow is discretized with the boundary element method. A series of hypothetical examples are analyzed. These examples consist of sets of Monte-Carlo simulations of flow through a series of networks generated from the same statistical distributions. The examples lead to the following conclusions. Large fractures and high fracture density implies good connectivity in the networks. A high fracture density implies a small variance in the flow through the network. Trace conditioning decreases estimation variance only when the fracture network consists of large fractures. Fracture statistics can be estimated reasonably well from fracture traces observed on a wall. (Author's abstract)
W88-04308

PARAMETER ESTIMATION THROUGH GROUNDWATER TRACER TESTS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04311

STUDY OF THERMALLY INDUCED CONVECTION NEAR A HIGH-LEVEL NUCLEAR WASTE REPOSITORY IN PARTIALLY SATURATED FRACTURED TUFF,
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W88-04317

RADIOACTIVITY OF THE ATOMIC SPA AT PODCETRTEK, SLOVENIA, YUGOSLAVIA,
Institut Jozef Stefan, Ljubljana (Yugoslavia).
I. Kobal, and A. Renier.
Health Physics HLTPAO, Vol. 53, No. 3, p 307-310, September 1987. 4 tab, 20 ref.

Descriptors: *Water pollution effects, *Thermal springs, *Uranium radioisotopes, *Radon radioisotopes, *Radium radioisotopes, Drinking water, Radioisotopes, Air pollution, Health effects, Tissue analysis, Bioaccumulation, Yugoslavia.

The thermal spring near Podcetrtek in northeastern Slovenia has been used for therapeutic purposes since 1966. Chemical analysis of the water places it among magnesium-calcium carbonate waters (following balneological criteria), with a temperature of 30-37 C. The aim of this work was to determine the radioactivity (Rn-222, Ra-226 and U) of the spa water prescribed for drinking and healing purposes and to determine the Rn-222 content of the air in rooms with therapeutic facilities, thus estimating the dose received by a patient during a stay at the spa, as well as by the permanent personnel. Investigations show that the values of atmospheric Rn concentrations are relatively low and are generally comparable to those found in homes in Slovenia made of concrete and ventilated during the summer (as are the spa buildings). As Radium intakes for a fortnight's stay, were valved in committed dose equivalents of 0.07 micro Sv for gonads, 0.5 micro Sv for red bone marrow, and 5.5 micro Sv for bone surface were calculated for drinking water as the source. A bronchial dose (due to Rn) of 107 micro Sv is calculated for inhalation. The annual intake of Rn for a doctor or nurse is estimated at 120 kBq, and the resulting bronchial dose due to Rn and its short-live decay products is 6.8 mSv. (Airone-PTT)
W88-04329

SOIL WATER EFFECTS ON CONCENTRATION PROFILES AND VARIATIONS OF RN-222 IN A VADOSE ZONE,
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
M. Fukui.
Health Physics HLTPAO, Vol. 53, No. 2, p 181-186, August 1987. 9 fig, 18 ref.

Descriptors: *Path of pollutants, *Soil water, *Radon, *Vadose water, *Soil gases, Radioisotopes, Soil profiles, Atmospheric pressure, Rainfall, Groundwater level, Pollutant identification, Soil contamination.

Concentration profiles of Rn-222 and their variations were studied to understand the vertical motion in the ground caused by fluctuations of meteorological parameters such as precipitation, groundwater level and atmospheric pressure. A method of trapping Rn-222 was developed to measure the concentration profiles by circulating and bubbling soil gas in porous cups into toluene. For locations where the water table is close to the surface, observations showed a peak concentration in the vertical profile of Rn-222 at about a 40-cm depth and revealed that the concentration in soil gas decreases as soil moisture increases near the water table. Soil gas in a buried vessel also was circulated continuously to monitor Rn-222 in the ground air near the surface using an ionization chamber. A rising of the water table following precipitation causes a burst of Rn-222 concentration by upflow in the ground, though the concentration in the soil gas soon decreases with the intake of air above the surface due to increasing atmospheric pressure following precipitation. The concentration in soil gas again increases via the phenomenon accompanying the recovery of equilibrium in soil water between Rn-222 and Ra-226. (Author's abstract)
W88-04330

MODELING OF BIOLOGICAL PROCESSES IN THE SUBSURFACE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-04361

2G. Water In Soils

LONG-TERM EFFECTS OF TILLAGE ON THE RETENTION AND TRANSPORT OF SOIL WATER,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
H. D. Scott, L. S. Wood, and W. M. Miley.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149316/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 125, June 1986. 39 fig, 12 tab, 16 ref, append. Contract No. 14-08-0001-G1004. Project No. USGS G1004-05.

Descriptors: *Irrigation requirements, *Soil water transport, *Soil-water-plant relationships, Green manure, Soil conservation, Arkansas, Water quality.

Quantitative measurements were made of the physical and chemical properties of two virgin prairie soils, Crowley and Jay, that remain in their native Arkansas environments and of similar soils that had been tilled extensively. Comparisons were made of soil properties at six depths. When compared with the tilled soils the virgin soils had higher organic matter contents, saturated hydraulic conductivities, and water retained at several applied pressures. Bulk densities and hydraulic resistances were lower in the virgin soils. For the Crowley silt loam, values of pH and elemental contents of the virgin soil were higher than those of tilled soil. Determinations also were made of the effects of a 14-year addition of green manure on a Dubbs-Dundee soil during the spring on continuous cotton production. In general, the green manure tended to increase hydraulic conductivity and water retention. (USGS)
W88-03501

DRAINED DEFORMATION AND FAILURE DUE TO CYCLIC PORE PRESSURES IN SOFT NATURAL CLAY AT LOW STRESSES,
Lakehead Univ., Thunder Bay (Ontario).
K. D. Eigenbrod, J.-P. Burak, and J. Graham.
Canadian Geotechnical Journal CGLOAH, Vol. 24, No. 2, p 208-215, May 1987. 12 fig, 16 ref.

Descriptors: *Mass wasting, *Soil water movement, *Soil creep, *Soil deformation, *Clays, *Interstitial water, Drainage, Groundwater, Stress, Strain, Anisotropy, Freeze-thaw cycles, Frost action.

Slow, recurring downslope movements in northern climates are frequently referred to as creep movements, and are usually related to outwards freezing followed by vertical thawing movements. An alter-

native mechanism is examined in the reported test data. Undisturbed block samples of proglacial clay from a slope near Yellowknife, N.W.T., have been tested by cyclically varying the pore-water pressure in triaxial specimens by an amount Delta u, and measuring the resulting strains per cycle. The specimens were initially anisotropically consolidated with normal and shear stresses corresponding to those in the moving mantle. Drainage was permitted throughout the testing. This procedure represents changes that can occur in a natural slope from (a) seasonal groundwater level changes and (b) elevated pore-water pressures that accompany thawing. After 60-100 cycles, the pore-water pressure was systematically increased to the value at which the samples failed. This occurred on a steep, low-stress envelope. The strains per cycle were approximately linear in the range 30-100 cycles. As a first approximation they have been modelled as varying linearly with pore water pressure almost up to failure. (Author's abstract)
W88-03753

THERMALLY INDUCED HEAVE BENEATH CHILLED PIPELINES IN FROZEN GROUND,
Hardy Associates, Calgary (Alberta).
For primary bibliographic entry see Field 2C.
W88-03756

EMISSIONS OF BIOGENIC SULPHUR COMPOUNDS FROM SEVERAL WETLAND SOILS IN FLORIDA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2L.
W88-03776

EVALUATION OF SIMPLE, DYNAMIC SOIL MOISTURE MODEL,
Portland State Univ., OR. Dept. of Civil Engineering.
R. W. Koch, R. L. Allen, and N. D. Mtundu.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 288-302, August 1987. 8 fig, 2 tab, 25 ref. NSF Grants CEE-8404738.

Descriptors: *Soil water, *Evapotranspiration, *Drainage, *Irrigation, *Model studies, *Agriculture, Field tests, Dynamics, Root zone, Climate, Vegetation, Soil types.

The dynamics of soil moisture in the root zone is of fundamental importance in agricultural water management. A simple, yet physically based model is presented which describes the processes of redistribution of the soil moisture profile, drainage, and evapotranspiration (ET) from the root zone. Using the sharp wetting front approximation, relatively simple expressions are derived that are explicit in parameters describing the soil and climate/vegetation properties. Application of these models using parameter values selected a priori indicates good results. Comparison of the redistribution and drainage models with laboratory data shows good agreement, as does comparison of the ET model with field soil moisture measurements. Uncertainty in soil parameters, root zone depth, and timing of irrigation applications affect model performance. (Author's abstract)
W88-03781

SIMPLE LABORATORY MEASUREMENT OF UNSATURATED HYDRAULIC CONDUCTIVITY,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
Z. A. Samani, and L. S. Willardson.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 405-412, August 1987. 5 fig, 3 tab, 11 ref.

Descriptors: *Analytical methods, *Soil water, *Hydraulic conductivity, *Unsaturated flow, *Permeability coefficient, *Upward infiltration method, Laboratory tests, Absorption, Wetting, Comparison studies, Water pressure.

A simple method called 'upward infiltration method' is described for using common soil laboratory equipment to measure unsaturated hydraulic conductivity of soil samples in a short time. The method is based on measurement of water absorption rates under controlled tensions, which leads to an estimate of soil hydraulic conductivity during the wetting phase. The results are compared with those evaluated by the constant application rate method, the small increments of pressure change method, the one-step method, and Jackson's theoretical model. The results of the upward infiltration method are in close agreement with the constant application rate method and are generally higher than the one-step method and lower than Jackson's theoretical model. The measurement by this method is limited to about one meter of negative water pressure. (Author's abstract)
W88-03789

NOTE ON THE EFFECT OF FALLOWING ON WATER STORAGE AND LOSS AS DETERMINED FROM A LYSIMETER FOR A TROPICAL CLAY SOIL,
Kenya Agricultural Research Inst., Nairobi.
J. O. Mugah, and J. L. Stewart.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 243-247, October 1986. 7 tab, 5 ref.

Descriptors: *Water storage, *Water loss, *Lysimeters, *Tropical regions, *Soil water, *Clays, *Fallowing, Evaporation, Available water, Cropland, Kenya.

A major management agronomic strategy in relatively dry areas with more than one rainy season is that of fallowing, a practice in which the soil is left uncropped and kept free of weeds for at least one rainy season. The moisture stored during this period presumably augments that available to the crop during the cropping period that follows. The effectiveness of fallowing a particular soil depends largely on the water storage capacity of the soil in relation to the remaining water balance components during the fallowing period. A large weighing lysimeter was used to determine water accumulation, storage, and loss from a fallow tropical clay soil. For the bare soil, the proportion of accumulated water lost as evaporation depends on the depth of soil covered by the water as well as on the frequency of wetting; shallow, frequent wettings result in higher proportions of evaporative losses. Provided runoff losses are minimized and accumulated water infiltrates deep enough into a bare soil, the rate of decrease of stored water below field capacity will remain negligibly small over time. Drainage losses do not materially reduce water stored below field capacity, as the process also proceeds at a negligibly slow rate once field capacity has been reached. This was all quantified for tropical conditions by the authors. These kinds of measurements are relatively rare for the tropics. (Ray-PTT)
W88-03877

ROLE OF LATERAL STRESSES ON SOIL WATER RELATIONS IN SWELLING CLAYS,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
B. G. Richards.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 4, p 457-476, 1986. 11 fig, 1 tab, 37 ref.

Descriptors: *Soil water potential, *Clays, *Soil water, *Soil mechanics. Stress, Soil properties.

The moisture characteristic of a swelling soil is the result of complex interaction between the soil water potential and imposed mechanical stresses. This can give rise to soil water profiles which cannot be interpreted by soil water theories for non-swelling soils. Agricultural soil physics has been concerned primarily with highly structured surface soils, and has developed simple theories for the effects of stress on soil water relations in swelling soils. These simple theories ignore the effect of lateral stress in the soil. Civil engineers, on the other hand, dealing mainly with complex soils at depth, have developed more complex theories for the effect of three-dimensional stress on soil water relations. The effect of three-dimensional stress can and should be included in soil water studies of swelling soils the possible magnitude of such effects. (Author's abstract)
W88-03879

METHODS TO EXPERIMENTALLY CONTROL WATERLOGGING AND MEASURE SOIL OXYGEN IN FIELD TRIALS,
Western Australia Dept. of Agriculture, South Perth.
E. G. Barrett-Lennard, P. D. Leighton, I. R. McPharlin, T. Setter, and H. Greenway.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 4, p 477-83, 1986. 2 fig, 2 tab, 23 ref.

Descriptors: *Waterlogging, *Soil oxygen, *Field tests, *Soil water, Plant growth, Crop yield.

Waterlogging has substantial adverse effects on the growth of crops. However, the effects of waterlogging on plant growth are difficult to study under field conditions. The authors describe a method of waterlogging which takes into account various factors which affect this phenomenon uses special plots constructed at a site with a loamy sand overlying an indurated siliceous pan of low hydraulic conductivity. The plots were isolated from lateral water flow with polyvinyl chloride sheeting, and were either waterlogged or drained by subirrigation or drainage through slotted polyethylene pipe buried 0.45 meter below the soil surface. In a test of the plots, waterlogging was imposed for 26 days. Samples of soil water were removed from waterlogged plots for the measurement of oxygen. Concentrations of oxygen rapidly decreased after the commencement of waterlogging, but increased after drainage. (Ray-PTT)
W88-03880

EFFECT OF SLAUGHTERHOUSE EFFLUENT AND WATER IRRIGATION UPON AGGREGATION IN SEASONALLY DRY NEW ZEALAND SOIL UNDER PASTURE,
New Zealand Soil Bureau, Lower Hutt.
For primary bibliographic entry see Field 5E.
W88-03881

FIELD METHODS FOR UNSATURATED HYDRAULIC CONDUCTIVITY AND SORPTIVITY,
Hawaii Univ. at Manoa, Honolulu. Coll. of Tropical Agriculture.
R. E. Green, and S.-K. Chong.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183166/AS. Price codes: A02 in paper copy, A01 in microfiche. Hawaii Water Resources Research Center Technical Completion Report No. 67, Honolulu. June 1983. 14 p, 16 ref. Contract No. 14-34-0001-0113. Project No. OWRT A-078-HI (1).

Descriptors: *Hydraulic permeability, *Hawaii, *Sorption, *Permeability coefficient, *Fluid mechanics, Hydraulic gradient, Pellicular water, Soil moisture meters, Soil porosity, Percolation, Drainage, Infiltration.

Field methods which have been successfully used in Hawaii to measure soil hydraulic conductivity and sorptivity are described. The simplified unsteady drainage-flux method assumes a unit hydraulic gradient during drainage and negligible horizontal flow in the soil layer. The field set-up for the simplified method requires an infiltration ring (at least 0.3 m in diameter) with a buffer zone around the inner ring. Hydraulic conductivity at field saturation is estimated by the measurement of steady infiltration using a neutron moisture probe or soil sampling at various times during drainage with gravimetric determination of water content. In the measurement of sorptivity (S) by ponded infiltration, it is possible to measure the value of S for a given antecedent water content by measuring the cumulative infiltration versus time immediately following the application of water. In the field sorptivity is calculated by measuring the cumulative infiltration using a single-ring infiltrometer in soil where there is negligible flow through cracks and channels. (Geiger-PTT)
W88-03942

EXPERIMENTAL AND NUMERICAL ANALYSES OF PERCHED GROUNDWATER MOUNDS BELOW SEPTIC SYSTEMS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W88-04037

CUMULATIVE MASS COORDINATE TO DETERMINE WATER PROFILE CHANGES IN VARIABLE VOLUME SOIL,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Soils
D. McGarry, and K. W. J. Malafant.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 850-854, July-August 1987. 2 fig, 3 tab, 17 ref.

Descriptors: *Infiltration, *Irrigation effects, *Surface-groundwater relations, *Soil water, *Variable-volume soils, *Soil properties, Mathematical studies, Mathematical analysis, Cumulative mass coordinates.

A method for calculating changes in soil water of variable volume soil using a cumulative mass coordinate is demonstrated. Water content on a mass basis is plotted against mass per unit area of soil solids rather than against depth, lines are fitted, and changes in soil water in zones of gain or loss are calculated from areas between lines. A second method assesses the need for the cumulative mass coordinate by demonstrating its relation to profile depth. Application of the methods is demonstrated through a worked example using field data taken from an experiment to study the change in soil physical condition caused by land preparation at a range of soil water profiles for furrow-irrigated cotton. The results showed that the cumulative mass coordinate is indirectly applicable to samples collected in the field, without supplementary measurements required by other methods. (Lantz-PTT)
W88-04038

CLAY DISPERSION AND HYDRAULIC CONDUCTIVITY OF SOME SALT-AFFECTED ARID LAND SOILS,
Barani Agricultural Coll., Rawalpindi (Pakistan). Dept. of Soil Science.
M. Yousaf, O. M. Ali, and J. D. Rhoades.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 905-907, July-August 1987. 3 fig, 1 tab, 11 ref.

Descriptors: *Soil water, *Infiltration, *Permeability coefficient, *Clays, *Dispersion, *Saline soils, *Arid lands, Sodium adsorption ratio, Electrolytes, Chemical analysis, Soil properties.

Cumulative clay dispersion from four arid land soils were compared with their relative hydraulic conductivities as affected by electrolyte concentration and sodium adsorption ratio (SAR). As electrolyte concentration decreased and SAR increased, clay dispersion increased and hydraulic conductivity decreased correspondingly. Threshold relations between electrolyte concentration and SAR associated with clay dispersion of 5 g clay/kg soil corresponded well with hydraulic conductivity threshold relations. This correspondence between clay dispersion and sodicity-related reductions in soil hydraulic conductivity can be utilized to provide an index based on clay dispersion for screening soils for their sodicity hazard sensitivity and for predicting reductions in soil hydraulic conductivity related to soil and water sodicity. (Author's abstract)
W88-04040

DISPERSION OF CLAY FROM SOME SALT-AFFECTED, ARID LAND SOIL AGGREGATES,
Barani Agricultural Coll., Rawalpindi (Pakistan). Dept. of Soil Science.
M. Yousaf, O. M. Ali, and J. D. Rhoades.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 920-324, July-August 1987. 3 fig, 4 tab, 13 ref.

Descriptors: *Permeability coefficient, *Clays, *Dispersion, *Saline soils, *Arid lands, Sodium adsorption ration, Electrolytes, Chemical analysis, Soil properties.

The dispersion characteristics of five arid land soils were determined upon reaction with solutions having various levels of electrolyte concentrations (C = 0, 1, 4, 10, 30, 50, and 100 mmol/L), and sodium adsorption ratios, SAR (0, 5, 10, 20, and 40) with either Ca or Mg as the divalent counterion. With either divalent cation, clay dispersion increased as SAR increased and C decreased. Greater dispersion was observed with Mg as the divalent counter-ion due to the higher SAR and lower C levels, which resulted in the Mg systems compared to the Ca systems when the soils were reacted with comparable SAR and C treatment solutions. Dispersion threshold relations are concluded to be a useful criterion for screening soils for their sodicity hazard potentials. (Author's abstract)
W88-04041

SIMULATING THE EFFECTS OF SOIL DEPTH AND CLIMATIC FACTORS ON CORN YIELD,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
J. B. Swan, M. J. Shaffer, W. H. Paulson, and A. E. Peterson.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 1025-1032, July-August 1987. 11 fig, 7 tab, 37 ref.

Descriptors: *Simulation analysis, *Soil water, *Corn, *Crop yield, *Plant growth, Soil water table, Precipitation, Model studies, Water stress, Crop production.

Measured corn yields (Zea mays L.) from a tillage-residue management study on the Univ. of Wisconsin Lancaster Experiment Station were compared to simulated yields determined using the Nitrogen-Tillage-Residue Management (NTRM) simulation model. Data collected at the site from 1982 to 1985 on crop, soil, climate, and management characteristics were utilized in the model. A significant interaction effect on corn yield was observed between climate and soil-water-holding capacity of individual plots. In 1983, 1984, and 1985 corn yields increased as soil depth to red clay residuum increased: in 1981 and 1982 corn yield had little relationship to soil depth to residuum. The observed differential effect of soil depth to residuum on corn yield under different years' climatic conditions required the use of a simulation model to estimate corn yield accurately in a given year and to express the probability of obtaining a given yield level. Frequency distributions for grain yield were determined for specific soil depths to residuum. Grain yield was determined as a function of soil depth for specific probability levels based on simulated site-specific daily climatic values generated for a 100-yr period. Yields predicted by the NTRM model corresponded closely to measured yields, indicating that the model successfully accounted for the effect of plant available water-holding capacity (PAW), precipitation, and management on corn yield at this location. (Lantz-PTT)
W88-04044

PHOSPHORUS FERTILIZER CARRIERS AND THEIR PLACEMENT FOR MINIMUM TILL CORN UNDER SPRINKLER IRRIGATION,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W88-04045

EFFECT OF REGIONAL SLOPE ON DRAINAGE NETWORKS,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
L. F. Phillips, and S. A. Schumm.
Geology GLGYB, Vol. 15, No. 9, p 813-816, September 1987. 4 fig, 2 tab, 8 ref. NASA Grant NAGW-535 and Army Research Office Grant No. DAAG 29-84-K-0189.

Descriptors: *Geomorphology, *Erosion, *Drainage patterns, *Soil water, *Geohydrology, Slope, Hillsides, Homogeneity.

Drainage networks that develop under conditions of no structural control and homogeneous lithology are generally dendritic, depending upon the shape and inclination of the surface on which they form. An experimental study was designed to investigate the effect of an increase of slope on the evolution and development of dendritic drainage patterns. As slope steepens, the pattern changes from dendritic at 1% slope, to subdendritic at 2%, to subparallel at 3%, to parallel at 5% and higher. The change from a dendritic-type pattern to a parallel-type pattern occurs at a low slope, between 2% and 3%, and primary channel junction angles decrease abruptly from about 60 to 43 F. (Author's abstract)
W88-04055

ANALYSIS OF HILLSIDE SEEPAGE,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W88-04064

PROTECTING GROUNDWATER FROM VIRAL CONTAMINATION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5G.
W88-04123

DRAINAGE FROM LAYERED FIELD SOILS: FIXED GRADIENT MODELS,
Kansas State Univ., Manhattan. Dept. of Agronomy.
J. B. Sisson.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2071-2075, November 1987. 3 fig, 15 ref.

Descriptors: *Drainage, *Soil water, *Groundwater movement, *Mathematical models, Permeability coefficient, Mathematical equations, Mathematical analysis, Hydraulic head.

Fixed gradient models result when the gradient term in the soil moisture equation is assumed to vary only with depth (remains invariant in time). The fixed gradient assumption results in a first-order partial differential equation that is transformable to a mathematical form identical to that for a uniform soil. When the transformation was applied to field data, all water content data were found to plot along a single curve. Assuming a fixed gradient and an exponential form for hydraulic conductivity times hydraulic head, resulted in a fitted curve with an r-squared = 0.847 (d.f. - 405) when data from three sites and seven depths were used. Assuming a power function for hydraulic conductivity times hydraulic head resulted in a similar r-squared. Prior to applying the transform, hydraulic conductivity required 42, 42, and 63 parameters to fit data obtained at the 21 spatial points sampled, assuming a Davidson, Watson or Brooks and Corey function, respectively. With the transform 23, 23, and 24 parameters were required for the three hydraulic conductivity times hydraulic head functions, respectively. (Author's abstract)
W88-04184

UNSTABLE FLOW IN LAYERED SOILS: A REVIEW,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5B.
W88-04240

SOIL WATER DYE TRACING, WITH SPECIAL REFERENCE TO THE USE OF RHODAMINE WT, LISSAMINE FF AND AMINO G ACID,
Sheffield Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-04241

SIMULATION OF SOLUTE TRANSPORT USING A CONTINUOUS TIME MARKOV PROCESS: 1. THEORY AND STEADY STATE APPLICATION,
North Dakota State Univ., Fargo. Dept. of Soil Science.

For primary bibliographic entry see Field 5B.
W88-04312

SIMULATION OF SOLUTE TRANSPORT USING A CONTINUOUS TIME MARKOV PROCESS: 2. APPLICATION TO TRANSIENT FIELD CONDITIONS,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W88-04313

SELECTIVE TRANSPORT OF HYDROCARBONS IN THE UNSATURATED ZONE DUE TO AQUEOUS AND VAPOR PHASE PARTITIONING,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-04314

EFFECTS OF HYSTERESIS WITH AIR ENTRAPMENT ON WATER FLOW IN THE UNSATURATED ZONE,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. J. Kaluarachchi, and J. C. Parker.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1967-1976, October 1987. 14 fig, 2 tab, 30 ref.

Descriptors: *Infiltration, *Hysteresis, *Soil water, *Aeration zone, *Flow discharge, *Air entrapment, Soil water content, Soil properties, Hydraulic properties, Models studies, Mathematical models, Mathematical equations, Finite element method, Evaporation.

Effects of hysteresis with air entrapment on water content and head distributions, surface fluxes, and water balance components are investigated by finite element simulations of flow in one- and two-dimensional spatial domains. Results of one-dimensional analyses indicate that effects of hysteresis are markedly influenced by surface boundary conditions and to a lesser extent by initial concentrations. Stipulation of flux-controlled boundary conditions results in minimal hysteretic effects, while potential-type boundary conditions produce substantial deviations between hysteretic and nonhysteretic simulations. The latter effects are attributable in large part to differences in surface conductivity associated with air entrapment. Predicted water content distributions for nonhysteretic simulations using main drying functions deviated much more from hysteretic model results than did predicted water content distributions for nonhysteretic simulations based on main wetting functions. For two-dimensional problems, predicted infiltration, evaporation, and seepage fluxes and soil water storage changes were much higher for nonhysteretic simulations using main drying functions than for hysteretic simulations; predictions based on main wetting functions deviated less markedly from hysteretic simulations. Introduction of heterogeneity in the porous medium diminished effects of hysteresis on infiltration and seepage but accentuated differences in evaporation due to interactions between evaporation and seepage boundaries, suggesting that the influence of heterogeneity on hysteretic effects will be problem-specific. (Author's abstract)
W88-04318

MODELING OF EVAPOTRANSPIRATION FROM HOMOGENEOUS SOILS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2D.
W88-04322

SOIL WATER EFFECTS ON CONCENTRATION PROFILES AND VARIATIONS OF RN-222 IN A VADOSE ZONE,
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
For primary bibliographic entry see Field 2F.
W88-04330

COMPARISON OF TWO METHODS FOR SIMULATION OF SOIL-WATER BALANCE PROCESSES WITH SPECIAL REGARD TO GROUND-WATER RECHARGE (VERGLEICH ZWEIER METHODEN ZUR SIMULATION DER PROZESSE DES BODENWASSERHAUSHALTS, VORNEHMLICH DER GRUNDWASSERNEUBILDUNG),
Amt fuer Wasser- und Abfallwirtschaft, Muenster (Germany, F.R.).
M. Schroeder, and B.-P. Hamels.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 73-76, July 1987. 3 fig, 1 tab, 7 ref.

Descriptors: *Infiltration, *Recharge, *Groundwater movement, *Soil water, *Simulation analysis, *Groundwater recharge, Model studies, Percolation rate, Computer programs, Aeration zone, Seep water.

A soil moisture storage model and a physical deterministic model have been tested for their efficiency in computation of percolation rates, taking the measurement data from a weighable lysimeter as a basis. It has been found that only the physical model is able to provide sufficiently accurate data of high spatial and temporal resolution, and that the cumulative curves are not suitable for assessing the model quality. The storage model only approximately describes the situation in the uppermost root zone. However, it does yield useful data on the annual volumes of cumulative percolation. (Author's abstract)
W88-04350

2H. Lakes

QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS - II,
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 7C.
W88-03499

LOCAL WATER RESOURCE INFORMATION MANAGEMENT SYSTEM,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W88-03504

REDUCTION OF MICROBIAL INDICATORS AND VIRUSES IN A CYPRESS STRAND,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W88-03559

PRACTICAL APPROACH TO THE EVALUATION OF THE CONSERVATION STATUS OF VEGETATION IN RIVER CORRIDORS IN WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
F. M. Slater, P. Curry, and C. Chadwell.
Biological Conservation BICOBK, Vol. 40, No. 1, p 53-68, May 1987. 2 fig, 6 tab, 18 ref.

Descriptors: *Wales, *Riparian vegetation, *Species diversity, *Population density, *Comparison studies, *River basins, *River ecology, River banks, River conservation, Legislation, Habitats, River basin development, Waterways.

A methodology for the evaluation of the conservation interest of river corridor vegetation is described and suggestions made for its improvement. Of the attributes used for describing and grading sites, species richness and site uniqueness proved more useful than species rarity, mainly due to variations in the quality of recording and season. Bryophyte data, although often ecologically more informative than vascular plant data, are rarely obtainable due to a lack of competent recorders. Inter-recorder comparisons are recommended as difference between them were a major source of variation within the data. Comparisons of data with those from other surveys must be approached with caution as differing definitions of sampling zones, recordable taxa, time of year, purpose of survey and the state of flow of the river can all alter the recorder's perception of habitat and species abundance. (Author's abstract)
W88-03588

EXPERT SYSTEM APPROACH TO THE ASSESSMENT OF THE CONSERVATION STATUS OF RIVERS,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
J. H. O'Keeffe, D. B. Danilewitz, and J. A. Bradshaw.
Biological Conservation BICOBK, Vol. 40, No. 1, p 69-84, May 1987. 3 tab, 12 ref, append.

Descriptors: *South Africa, *Computer models, *Management planning, *River systems, *River ecology, *Model studies, *Stream classification, *Comparison studies, Assessments, Conservation, Biological properties, Physical properties, Computer programs, Catchment areas, Flow.

The aims and development of a computerized system for the assessment of conservation status in South African rivers is described. The system is designed to: facilitate the communication of river conservation priorities to managers, developers, and planners; provide a consistent but flexible method for classifying rivers according to their conservation status; and act as a semi-numerical model to simulate the effects of proposed development plans on specific rivers. The system is written in PROLOG to run on an IBM PC and accepts information about specific attributes of a river (e.g. number of indigenous fish species, amount of sewage effluent, etc.). Attribute weightings are modified by a series of rules related to the size of the river. An overall score between 0 and 100 for the conservation status of the river is calculated. In addition, the system provides a breakdown of scores by biota, catchment and the river itself, and by individual attribute. Confidence limits indicating the level of available information are calculated, and those attributes of greatest interest for the conservation of the river are identified, as are those attributes most urgently requiring further research. (Author's abstract)
W88-03589

FEW INTRA-LAKE VARIATIONS OF PHYSIOLOGICAL PARAMETERS IN PERCH, PERCA FLUVIATILIS,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
C. Haux, A. Larsson, M. L. Sjobeck, and G. Lithner.
Comparative Biochemistry and Physiology (A) CBPAB5, Vol. 86, No. 4, p 729-732, 1987. 1 fig, 1 tab, 15 ref.

Descriptors: *Perch, *Fish physiology, *Physiological ecology, *Baseline studies, *Limnology, *Lakes, *Yngern, Sweden, *Comparison studies, Gill nets, Lake fisheries, Temperature, Water pollution, Field tests.

Intra-lake variations in physiological parameters, representing haematology, plasma ion composition and carbohydrate metabolism, were investigated in perch inhabiting a comparatively unpolluted lake. Provided the perch were subjected to the standardized procedure (previously described by other authors) for capture, handling, recovery after capture, and sampling, only few and minor difference were observed in the 21 parameters investigated when three groups were compared to a control group. The experimental design used is suitable for the examination of the physiological status of perch in the field. (Author's abstract)
W88-03590

FLOOD IN THE DESERT,
Eckhoff, Watson, Preator Engineering, Salt Lake City, UT.
For primary bibliographic entry see Field 2E.

W88-03604

MICROBIAL IMPLICATIONS OF DIEL VARIATIONS IN WATER QUALITY PARAMETERS POSSIBLY ASSOCIATED WITH ACID DEPOSITION IN AN OLIGOTROPHIC RESERVOIR,
New England Research, Inc., Worcester, MA.
For primary bibliographic entry see Field 5C.
W88-03615

ABUNDANCE, GROWTH, AND FOOD SUPPLY OF WHITE SUCKERS (CATOSTOMUS COMMERSOND IN RELATION TO LAKE MORPHOMETRY AND PH,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-03675

UNEXPECTED CONSEQUENCES OF THE CONSTRUCTION OF A STORAGE DAM IN A DESERT COASTAL ZONE IN PERU (CONSEQUENCES INATTENDUES DE L'EDIFICATION D'UN BARRAGE-RESERVOIR EN ZONE COTIERE DESERTIQUE AU PEROU),
Societe Degremont, Rueil-Malmaison (France).
P. Mouchet.
Aqua AQUAAA, No. 4, p 181-190, 1987. 24 fig, 13 ref.

Descriptors: *Reservoirs, *Limnology, *Drought effects, *Floods, *Dams, Chlorides, Sulfates, Salinity, Corrosion.

The filling of a reservoir in northern Peru was followed by an exceptional period of drought which lasted five years. The planned flow was therefore not met; this resulted in the formation of sand islands of eolian origin in the river bed downstream from the dam; moreover, this sand contains a large amount of chlorides and sulfates. This has numerous consequences: limnological (excessive increase in water salinity), hydrological (floods when it rains again), and technological (corrosion of the metal structures for water treatment and distribution. Study of these phenomena made it possible to propose a relationship between the rate of corrosion and the chloride content and pH of water. (Author's abstract)
W88-03762

LIMNOLOGICAL CHARACTERISTICS, WATER QUALITY AND CONSERVATION MEASURES OF A HIGH ALTITUDE BOG AND RIVERS IN THE MALUTI MOUNTAINS, LESOTHO,
Orange Free State Univ., Bloemfontein (South Africa).
J. U. Grobbelaar, and P. Stegmann.
Water S. A. WASADV, Vol. 13, No. 3, p 151-158, July 1987. 9 fig, 5 tab, 24 ref.

Descriptors: *Rivers, *Bogs, *Limnology, *Maluti Mountains, *Water quality, *Streams, Macrophytes, Algae, Ions, Nutrients, Rainfall, Erosion, Sediments, Salts.

Bogs occur in cirque-shaped riverheads above 2,500 m above sea level in the Maluti and Drakensberg Mountains. Numerous streams drain these bogs and pools occur on some of them. These are temporary shallow waters which fill in the wet summer months. A benthic community of macrophytes with epiphytic algae usually covers the bottom of the waters. The ionic content which was low, is influenced by the high rainfall, erosion of the basalts and seepage from the soil peat deposits. The waters were moderately acidic, with an ionic dominance order of Ca > Mg > Na > KHCO3 > SO4 > Cl and low concentrations of N and P. The precipitation was acidic with a low ionic content, which was dominated by edaphic and anthropogenic sources. According to the primary productivity and nutrient contents, the streams were oligotrophic and the pools mesotrophic. Productivity of the benthic communities was much higher than that of the pelagic zone. The quality of the waters is good, being low in dissolved salts, nutrients and clear. Overgrazing and the presence of burrowing ice-rats has led to erosion and conservation measures are needed to protect these important filters and regulators of water in this important catchment area of southern Africa. (Author's abstract)
W88-03769

LAKE ACIDIFICATION MODEL: PRACTICAL TOOL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 900-915, August 1987. 8 fig, 2 tab, 29 ref, append.

Descriptors: *Lake acidification, *Model studies, *Seasonal variation, *Acid rain, *Acidity, *Alkalinity, *Acid lakes, *Limnology, *Reservoirs, *Lakes, Simulation, Snowmelt, Computers.

A two-layer time-variable model is developed to quantify seasonal variations of pH and alkalinity levels in acidic lakes. The model incorporates the CO2/HCO3(-)/CO3(-) equilibria with internal sources and sinks of alkalinity and acidity in the water column. External alkalinity and CO2 acidity loadings are also incorporated. The modeling framework is applied to the Bickford Reservoir in Massachusetts and to Woods Lake and Panther Lake in Adirondack Park, New York. In general, in-lake alkalinity generation by reduction processes in the Bickford Reservoir during the summer months is simulated by the model. The observed response to snowpack release in Woods Lake and Panther Lake during the spring months is also reproduced by the model. All three model applications are efficiently run on a personal computer system. (Author's abstract)
W88-03803

SUPERBUGS SPRING FROM HOT WATER,
Waikato Univ., Hamilton (New Zealand).
R. Daniel, H. Morgan, and J. A. Hudson.
New Scientist NWSCAL Vol. 113, No. 1548, p 36-40, February 1987.

Descriptors: *Thermophilic bacteria, *Bacteria, *Hot springs, *Photosynthetic bacteria, *Autotrophic bacteria, Enzymes, Water temperature, Temperature effects, Chemical properties.

The first thermophilic or heat-loving bacteria isolated from Old Faithful in Yellowstone Park by Thomas Brock of Indiana University. Some of these bacteria thrive at 70 C but the majority of this class of bacteria grow in hot springs at about 65 C. Most hot springs are either acidic or alkaline and the pH can vary between 2 and 4 or 7 to 9, respectively. Depending upon the pH and temperature, different kinds of bacteria are found in these springs. Because of the high temperature and frequent occurrence of sulfide ions the amount of dissolved oxygen in these waters is low. As a result anaerobic organisms proliferate. Mats of blue-green algae which thrive at the surface of medium hot pools aid in the growth of anaerobes by cutting down the supply of oxygen. Bacteria in hot springs derive their energy either from mats produced by photosynthetic bacteria or from dissolved organic compounds and minerals in the spring water collected during its passage through the geothermal source. The unusual stability of these bacteria under such hostile environments is probably due to small structural changes in their protein molecules. (Ray-PTT)
W88-03818

HIGH RATES OF CONSUMPTION OF BACTERIA BY PELAGIC CILIATES,
Georgia Univ., Sapelo Island. Marine Inst.
E. B. Sherr, and B. F. Sherr.
Nature NATUAS, Vol. 325, No. 6106, p 710-711, February 1987. 1 fig, 1 tab, 25 ref.

Descriptors: *Ciliates, *Benthic habitat, *Food Chains, *Fluorescent marker bacteria, *Bacteria, Bacterivory, Plankton.

Earlier studies concluded that protoza living on bacteria can not ingest particles of less than 1-2 micrometers in diameter and have such low cell-specific clearance rates that they can only grow in habitats of high bacteria population. Determination of new uptake rates of bacteria by such protoza (in water samples collected from the Duplin River, a salt marsh tidal embayment in Georgia) using fluorescently labeled bacteria of 0.6 micrometer diameter and under low bacteria concentration showed that these rates are 10-100 times higher than previously believed. This bacterivory of protoza may provide metazoan grazers with a simple two-step food chain of bacterioplankton. A zeiss universal epifluorescence microscope fitted with 75 watt Xenon lamp was used for determining the amount of bacteria ingested by protoza. In some of the experiments a separated treatment in which 0.5 micrometer fluorescent latex microspheres were added at approximately the same concentration as the fluorescent bacteria showed that protoza ingested the labeled bacteria at a rate 5-fold higher than for microsphere. These higher rates at low bacteria concentrations are supported by two other studies involving one marine and two fresh water organisms. (Ray-PTT)
W88-03822

CYANOBACTERIAL WATER-BLOOMS,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5C.
W88-03845

WATER-BORNE HYHOMYCETES OF THE WESTERN GHAT FORESTS,
Mangalore Univ. (India).
K. R. Sridhar, and K. M. Kaveriappa.
Indian Phytopathology IPHAU, Vol. 38, No. 3, p. 557-558, September 1985, 8 fig, 1 tab, 2 ref.

Descriptors: *Fungi, *India, *Leaf litter, Payasivine River, Rivers.

Water-borne hyhomycetes were isolated from the waters of the Payaswini River flowing through the Western Ghat forests of India during the months of October and December. Eight species of fungi were isolated in leaf litter and in the filtered river water. (Ray-PTT)
W88-03847

WATER-BORNE FUNGI OF KUNTHI RIVER IN SILENT VALLEY, KERALA,
Mangalore Univ. (India).
K. R. Sridhar, and K. M. Kaveriappa.
Indian Phytopathology IPHAU, Vol. 38, No. 2, p 371-372, June 1985. 2 fig, 5 ref.

Descriptors: *Fungi, *Kerala, *India, Microscopy, Kunthi River, Rivers, Leaves, Submerged plants.

Natural foam samples and submerged leaves were collected from the Kunthi River in the Silent Valley, Kerala, India. A total of 24 species of fungi were isolated from the natural foam and in the induced foam of incubated water containing the leaves. (Ray-PTT)
W88-03848

ART OF LAKE RESTORATION,
University of East Anglia, Norwich (England).
For primary bibliographic entry see Field 5G.
W88-03849

ECOLOGICAL MODELS AS SUPPORT SYSTEMS TO DECISIONS IN LAKE MANAGEMENT PLANNING,
Pavia Univ. (Italy). Centro di Ricerca sulle Acque.
For primary bibliographic entry see Field 5G.
W88-03863

ALDRIN, DIELDRIN, AND MERCURY PROFILES IN RECENT LAKE SEDIMENTS AT THE ROCKY MOUNTAIN ARSENAL, COLORADO,
Colorado Cooperative Fishery Research Unit, Fort Collins.

For primary bibliographic entry see Field 5B.
W88-03868

UPTAKE AND REGENERATION OF NITRATE BY EPILITHIC COMMUNITIES IN A NEARLY PRISTINE LOTIC ENVIRONMENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. J. Triska, V. C. Kennedy, and R. J. Avanzino.
In: USGS Water-Supply Paper 2270, 1985. p 91-98, 4 fig, 2 tab, 30 ref.

Descriptors: *Nitrates, *Streams, *Lotic environment, Path of pollutants, Fate of pollutants, Sediments, Nutrients.

Nitrate flux by epilithon was determined by change in nitrate concentration using chloride as a conservative tracer. The experiment was conducted in an acrylic plastic flow-through channel set in Little Lost Man Creek, Humboldt County, California. Nylon shading (92%) was used to select for an epilithic community similar to that of near-surface intragravel habitats. The channel was augmented with nitrate (7.0 micron moles/L) and phosphate (0.8 micron moles/L) to eliminate potential nutrient limitation. Uptake by the channel's epilithic community totaled 0.385 grams N during the first 15 days. Regeneration amounted to 0.396 g N; of that total, 0.298 grams were regenerated between days 15-20. Nitrate regeneration was highest at night and lowest during daylight hours. Maximum nitrate formation was 0.6 micron moles/L at a flow rate of 9.5 L/min. Community respiration exceeded net community primary production throughout the experiment. Dissolved organic nitrogen and particulate detritus were potential sources of reduced nitrogen. The observed nitrate regeneration indicates that intragravel communities may contribute nitrate as water is transported downstream, even in pristine streams, with low ammonium concentration. (See also W88-03884) (USGS)
W88-03891

STREAMBED OXYGEN DEMAND VERSUS BENTHIC OXYGEN DEMAND,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03892

RATE OF FERROUS IRON OXIDATION IN A STREAM RECEIVING ACID MINE EFFLUENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03893

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WATER AND SEDIMENT IN SCOFIELD RESERVOIR, CARBON COUNTY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. M. Waddell, D. W. Darby, and S. M. Theobald.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2247, 195. 36 p, 23 fig, 10 tab, 16 ref.

Descriptors: *Stratification, *Sedimentation rate, *Limnology, *Reservoirs, *Utah, *Nutrients, *Calcium carbonate, Thermal stratification, Eutrophication, Carbon County.

Evaluations based on the nutrient content of the inflow, outflow, water in storage, and the dissolved-oxygen depletion during the summer indicates that the trophic state of Scofield Reservoir, Utah, is borderline between mesotrophic and eutrophic and may become eutrophic unless corrective measures are taken to limit nutrient inflow. Sediment deposition in Scofield Reservoir during 1943-79 was estimated to be 3,000 acre-feet. The deposition has decreased the original storage capacity by 4%. Age dating of bottom sediments, based on the radioisotope lead-210, indicates that most of the coal deposition in the reservoir occurred prior to about 1950. Scofield Reservoir is dimictic with turnovers occurring in the spring and autumn. Water in the reservoir circulates completely to the bottom during turnovers. The concentration of dissolved oxygen decreases with depth except during part of the turnover periods. Below an altitude of about 7,590 ft where 20% of the water is stored, the concentration of dissolved oxygen was less than 2 milligrams/L during most of the year. During the summer stratification period, the depletion of dissolved oxygen in the deeper layers is coincident with supersaturated conditions in the shallow layers; this is attributed to photosynthesis and respiration in the reservoir. (USGS)
W88-03897

WATER QUALITY OF LAKE GRANBURY, NORTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
F. Andrews, and J. L. Strause.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Texas Department of Water Resources, Austin, Report 284, 1983. 147 p, 14 fig, 29 tab, 10 ref.

Descriptors: *Water quality, *Reservoirs, *Texas, Surface waters, Dissolved oxygen, Dissolved solids, Iron, Manganese, Nitrogen, Phosphorus, Chloride, Sulfate, Hardness, Lake Granbury, Limnology.

During water years 1970-79, the concentrations of the major dissolved constituents in Lake Granbury on the Brazos River in north-central Texas averaged about 1,800 milligrams/L of dissolved solids, 700 milligrams/L of chloride, and 350 milligrams/L of sulfate. The water was generally very hard. Thermal stratification in Lake Granbury usually begins during April and persists until September or October. Stratification causes significant seasonal and areal variations in the concentrations of dissolved oxygen, which in turn cause variations in the concentrations of dissolved iron and manganese, total inorganic nitrogen, and total phosphorus. During periods of summer stagnation, reducing conditions result in the dissolution of iron and manganese from the bottom deposits in the lake. At site AC, a deep site near De Cordova Bend Dam, iron concentrations in water near the bottom during summer stagnation ranged from 50 to 700 micrograms/L and averaged 230 micrograms/L. Manganese concentrations ranged from 1,300 to 3,700 micrograms/L and averaged 1,800 micrograms/L. During periods of winter circulation and in water near the surface during summer stagnation, both iron and manganese concentrations averaged less than 100 micrograms/L. The concentrations of total inorganic nitrogen and total phosphorus are greatest during the summer stagnation in water near the bottom at deep-water sites. At site AC during the summer, the concentration of total inorganic nitrogen averaged 2.37 milligrams/L and the concentration of total phosphorus averaged 0.19 milligrams/L. The concentrations of both these constituents in waters near the surface during the entire year and in bottom waters during the winter averaged 0.07 milligrams/L or less. (USGS)
W88-03928

WATER QUALITY OF LAKE WHITNEY, NORTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
J. L. Strause, and F. L. Andrews.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Texas Department of Water Resources, Austin. Report 290, 1984. 172 p, 15 fig, 31 tab, 12 ref.

Descriptors: *Water quality, *Reservoirs, *Texas, Surface waters, Stratification, Dissolved solids, Chlorides, Sulfates, Hardness, Dissolved oxygen, Iron, Manganese, Nitrogen, Phosphorus, Lake Whitney.

The volume-weighted average concentrations of the major dissolved constituents in Lake Whitney on the Brazos River in north-central Texas usually were less than 1,300 milligrams/L of dissolved solids, 500 milligrams/L of chloride, and 300 milligrams/L of sulfate during the 1970-80 water years. The water was very hard (hardness greater than 180 milligrams/L as calcium carbonate). Thermal stratification in Lake Whitney usually begins during April and persists until October. Stratification causes significant seasonal and areal variations in the concentrations of dissolved iron, dissolved manganese, total inorganic nitrogen, and total phosphorus. During summer stagnation, reducing conditions result in the dissolution of iron and manganese from the bottom deposits in the lake. At site AC, a deep site near Whitney Dam, dissolved iron concentrations in water near the bottom during summer stagnation ranged from 90 to 400 micrograms/L and averaged about 195 micrograms/L. Dissolved manganese concentrations ranged from 240 to 2,100 micrograms/L and averaged about 1,400 micrograms/L. The concentrations of total inorganic nitrogen and total phosphorus are greatest during summer stagnation in water near the bottom at deep sites. At site AC during the summer, concentration of total inorganic nitrogen near the bottom averaged 1.3 milligrams/L and the concentration of total phosphorus near the bottom averaged 0.28 milligrams/L. Seasonal temperature variations and variations in the concentration of dissolved oxygen result in dissolved iron, dissolved manganese, total inorganic nitrogen, and total phosphorus being recycled within the lake; however, no significant accumulations of these constituents were detected. (USGS)
W88-03944

PHYTOPLANKTON DISTRIBUTION IN THREE THERMALLY DIFFERENT BUT EDAPHICALLY SIMILAR REACTOR COOLING RESERVOIRS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5C.
W88-03990

WATER QUALITY ASSESSMENT: A SCREENING PROCEDURE FOR TOXIC AND CONVENTIONAL POLLUTANTS; PART 3,
Tetra Tech, Inc., Lafayette, CA.
W. B. Mills, J. D. Dean, D. B. Porcella, S. A. Gherini, and R. J. M. Hudson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-100016. Price codes: A22 in paper copy, A01 in microfiche. EPA-600/6-82-004, April 1982. Appendix D for Part 2. Contract No. 68-03-2673.

Descriptors: *Thermal stratification, *Limnology, Reservoirs, Water quality, Water quality management, Pollutants, Temperature, Biochemical oxygen demand, Nutrients.

Thermal profiles are provided for a variety of impoundment sizes and geographic locations throughout the United States. The locations are arranged in alphabetical order. Within each location set, the profile plots are ordered by depth and hydraulic residence time. Locations of water bodies in this study include Atlanta, Georgia; Billings, Montana; Burlington, Vermont; Flagstaff, Arizona; Fresno, California; Minneapolis, Minnesota; Salt Lake City, Utah; San Antonio, Texas; Washington, D.C.; and Wichita, Kansas. This material is an appendix to a manual for assessing the loading and fate of conventional pollutants and toxic pollutants in streams, impoundments, and estuaries. (Halterman-PTT)
W88-03992

GROWTH AND SURVIVAL OF PERITRICH CILIATES IN AN URBAN STREAM,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
Y. Kusuoka, and Y. Watanabe.
Oecologia OECOBX, Vol. 73, No. 1, p 16-20, August 1987. 8 fig, 20 ref.

Descriptors: *Population growth, *Protozoa, *Streams, Aquatic environment, Aquatic animals, Ecosystems, Survival.

A computerized system was devised to trace the attachment, growth and disappearance of petrich ciliates in an urban river. By tracing the development of each Carchesium polypinum colony in the river, it was possible to estimate the actual growth rate of this species without considering the effect of immigration. The survival and colonization rates of the colonies and individuals of solitary species could also be estimated. C. polypinum showed high growth rates (r=1.370/day, doubling time 12.14 hr). The number of daily colonizers also increased at a high rate, and the combination of growth and colonization caused very high population increase rates at the area level. Because of its low survivorship, the rate of Vorticella microstoma increase was much lower than previously reported. The survival of solitary species and small colonies was lower than with large colonies, and fewer new colonizers survived with the development of the attached microbial community. (Author's abstract)
W88-04009

EXPERIMENTAL EVIDENCE FOR INTERACTIVE HABITAT SEGREGATION BETWEEN ROACH (RUTILUS RUTILUS) AND RUDD (SCARDINIUS ERYTHROPHTHALMUS) IN A SHALLOW EUTROPHIC LAKE,
Lund Univ. (Sweden). Dept. of Ecology.
L. Johansson.
Oecologia OECOBX, Vol. 73, No. 1, p 21-27, August 1987. 9 fig, 4 tab, 37 ref.

Descriptors: *Roaches, *Rudd, *Eutrophic lakes, Aquatic ecosystems, Limnology, Population growth, Food habits, Survival, Population dynamics, Aquatic animals, Ecosystems.

The competitive interactions between roach (Rutilus rutilus) and rudd (Scardinius erythrophthalmus) were investigated in two habitats, the open water and the water-lily zone. The growth rates of both species in enclosures were lower when confined together than when alone, demonstrating interspecific competition. Allopatric roach had the highest growth rate in both habitats although the open water was preferred. The diets of both species were dominated by zooplankton in both the open water and waterlily zones. In laboratory experiments, roach had significantly higher feeding rates than rudd when fed D. magna and Cyclops sp. The impact of roach on the mean sizes and densities of zooplankton in the enclosures, together with the results from the laboratory study, indicate that roach were competitively superior in the open water. Because of high mortality in the sympatric waterlily enclosure, no conclusions about interspecific competition in this habitat could be drawn. The observed habitat segregation between roach and rudd was at least partly interactive. (Author's abstract)
W88-04010

VARIABILITY IN THE CHEMISTRY OF ESTUARINE PLANTS AND ITS EFFECT ON FEEDING BY CANADA GEESE,
Marine Biological Lab., Woods Hole, MA.
R. Buchsbaum, and I. Valiela.
Oecologia OECOBX, Vol. 73, No. 1, p 146-153, August 1987. 5 fig, 2 tab, 38 ref. NSF Grant No. DEB 81-09-371.

Descriptors: *Estuaries, *Aquatic plants, *Chemical analysis, *Geese, Seasonal variation, Food habits, Eelgrass, Marsh grass, Nitrogen, Nutrients, Carbohydrates, Proteins.

The influence of interspecific and seasonal variations in plant chemistry on food choices by adult and gosling Canada Geese, Branta canadensis, on Cape Cod, Massachusetts, were investigated. The geese fed primarily on the abundant marsh grasses, Spartina spp., and rushes, Juncus gerardi, early in the growing season and switched to a greater dependence on eelgrass, Zostera marina, later. Forbs were generally avoided all season even when growing within patches of abundant species. The avoidance of forbs was related to their low abundance and their high concentrations of deterrent secondary metabolites. Differences in plant chemistry also determined the switch from marsh graminoids to Z. marina during the growing season. Marsh grasses were higher than Z. marina in nitrogen, particularly in the spring when the nitrogen requirement of geese is especially high. Z. marina was a better source of soluble carbohydrates and was the preferred food during the summer when the need to build up energy reserves may be more critical to geese than protein intake. Goslings, which require a diet higher in nitrogen than do adults, fed on marsh graminoids later into the growing season than the adults. The nitrogen content of the diets of goslings was significantly higher than that available to them in the plants, indicating that they selected for nitrogen. The diets of non-breeding adults in the spring and all geese in mid summer closely reflected the nutrient content of the plants. The diet of breeding adults was more similar to that of their goslings than to that of non-breeding adults. The effects of plant chemistry and the nutritional needs of geese on food choices were modified by the need to select a safe feeding site. (Author's abstract)
W88-04012

RELATIVE IMPORTANCE OF ACIDITY SOURCES FOR HUMIC LAKES IN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W88-04013

RATE OF ACIDIFICATION OF AQUATIC ECOSYSTEMS IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W88-04015

AQUATIC MICROBIAL ACTIVITY AND MACROFAUNAL PROFILES OF AN OKLAHOMA STREAM,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 5B.
W88-04019

APPLICATION OF PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY TO THE CHARACTERIZATION OF HUMIC SUBSTANCES RESULTING FROM DECAY OF AQUATIC PLANTS IN SEDIMENTS AND WATERS,
Perpignan Univ. (France). Lab. of Marine Sedimentalogy and Geochemistry.
F. Gadel, and A. Bruchet.
Water Research WATRAG, Vol. 21, No. 10, p 1195-1206, October 1987. 6 fig, 2 tab, 35 ref.

Descriptors: *Water analysis, *Aquatic plants, *Humic matter, *Decay, *Gas chromatography, *Mass spectrometry, Algae, Pyrolysis, Lakes, Phenols, Cresols, Lagoons, Humic acid, Fulvic acid, Organic compounds.

Pyrolysis-gas chromatography-mass spectrometry (GC-MS), elemental analysis and infra red (i.r.) spectroscopy reveal major differences between humic substances from aquatic plants (algae and aquatic phanerogams) and lagoonal, marine and lacustrine deposits. Algae are enriched in proteins and their pyrolysis yields numerous nitrogenous by-products (alkylpyrroles, nitriles and alkylpyridines) along with aromatic compounds which are thought to reflect the decomposition of individual amino-acids (styrene, toluene, phenol and p-cresol). These compounds are less abundant in the pyrolysis products of humic substances from phanerogams with increasing amounts of methoxyphenols, characteristics of lignins. In the deposits of the Kerguelen Islands and of a 'blue lake' in Greenland, the importance of algal populations is emphasized by pyrolysis products corresponding to nitrogenous and carbohydrate derivatives. Phenols and cresols in the pyrochromatograms of these samples are interpreted as evidence of polypeptides rather than lignin: p-cresol is much more abundant than the other cresols, suggesting the formation of phenols by way of tyrosine. Lagoonal sediments, in contrast, seem typical of intermixed development of algae and phanerogams. Differences between fulvic and humic acids are emphasized by the development of polyphenols and protein derivatives in humic acids compared to polysaccharide derivatives in fulvic acids. Other constituents revealed by PY-GC-MS include N-acetyl aminosugars, phthalates and aliphatic compounds. (Author's abstract)
W88-04022

PHOSPHATE EXCHANGE CHARACTERISTICS OF WET AND DRIED SEDIMENT SAMPLES FROM A HYPERTROPHIC RESERVOIR: IMPLICATIONS FOR THE MEASUREMENTS OF SEDIMENT PHOSPHORUS STATUS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W88-04025

SESTON DYNAMICS IN TWO TEXAS PRAIRIE STREAMS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
B. H. Hill, and T. J. Gardner.
American Midland Naturalist AMNAAF, Vol. 118, No. 1, p 85-93, July 1987. 3 fig, 2 tab, 32 ref.

Descriptors: *Seston, *Organic matter, *Texas, *Streams, Seasonal variation, Ecosystems, Particle size.

Particulate organic matter (seston) was sampled at weekly to monthly intervals between October 1984 and November 1985 in two Texas prairie streams. Discharge in these two streams ranged from 0-1,350 L/sec at Site 1 (2nd order) and 0-3,310 L/sec at Site 2 (3rd order). Seston concentration at Site 1 averaged 10.55 + or - 4.10 mg AFDW/L (Ash Free Dry Weight) and ranged from 0.81-232 mg AFDW/L. At Site 2 mean seston concentration was 15.09 + or - 4.28 mg AFDW/L, and ranged from 0.81-203 mg AFDW/L. Seasonally, highest seston concentrations were measured in autumn, averaging 45.8 mg AFDW/L at Site 1 and 40.8 mg AFDW/L at Site 2. Lowest seston concentrations and transport were measured in winter at both sites. Minimum seston concentrations averaged 2.9 and 6.6 mg AFDW/L, respectively, for Sites 1 and 2. Total seston concentrations at both sites were moderately to highly correlated with discharge, both seasonally and annually (r-squared = .52-.95). Seston transport averaged 1583 + or - 1037 mg AFDW/sec (range 0-313,794 mg AFDW/Sec) at Site 1 and 2177 + or - 1188 mg AFDW/sec (range 0-673,850 mg AFDW/sec) at Site 2. Transport was significantly greater (t-test, $p < .05$) at Site 2, even when adjusted to transport per unit discharge and watershed area. Median seston particle size at Site 1 averaged 60.8 + or - 0.9 micrometers, and ranged from 53.2-79.5 micrometers. Median particle size at Site 2 averaged 60.8 + or - 0.9 micrometers, with a range of 53.7-63.5 micrometers. Median particle size was significantly larger (t-test, $P<0.05$) at Site 1. There were no significant seasonal differences in median particle size at either site. Seston at both sites, and on most dates, was dominated by the ultrafine size fraction (0.45-41 micrometers), averaging 83% of the seston at Site 1 and 91% at Site 2. (Author's abstract)
W88-04052

INADEQUACY OF THE EUCARYOTE INHIBITOR CYCLOHEXIMIDE IN STUDIES OF PROTOZOAN GRAZING ON BACTERIA AT THE FRESHWATER-SEDIMENT INTERFACE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
S. C. Tremaine, and A. L. Mills.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 8, p 1969-1972, August 1987. 1 fig, 4 tab, 29 ref. National Science Foundation Grant BSR-8601087.

Descriptors: *Food chains, *Protozoa, *Grazing, *Water quality control, *Aquatic bacteria, *Cycloheximide, *Sediment-water interfaces, Inhibition, Microbiological studies, Lakes, Ecological effects,

Lake sediments, Anaerobic bacteria, Sensitivity analysis, Water quality.

Four guilds from a lake sediment-water interface microbial community were isolated and tested for sensitivity to cycloheximide (0.1 to 200 milligram/liter). Field experiments were conducted to compare the inhibition, dilution, and filtration methods for determining grazing rates. Cycloheximide inhibited anaerobic bacteria at 50 milligrams/liter, and inhibition of bacterial growth was observed in the grazing experiments. The results show that the assumption of selective inhibition of heterotrophic eucaryotes was violated and preclude the use of cycloheximide in grazing experiments. (Author's abstract)
W88-04085

ESTIMATES OF BACTERIAL PRODUCTION AND MORTALITY IN THE EBRO RIVER (SPAIN),
Barcelona Univ. (Spain). Dept. of Microbiology.
J. Martinez, J. Garcia, and J. Vives-Rego.
Letters in Applied Microbiology, Vol. 4, No. 5, p 145-147, 1987. 15 ref.

Descriptors: *Bacterial analysis, *Ebro River, *Mortality, *Productivity, *Bacteria, Thymidine incorporation method, Tracers, Isotopic tracers, Radioisotopes, Tritium, Ebro River, Spain, Mortality, Grazing, Growth rates.

In the terminal part of the Ebro River, bacterial production and mortality were studied. Bacterial production was estimated by the thymidine incorporation method and from estimates of growth rate. Bacterial mortality and grazing were studied using differential filtration of a H3-labelled population. Production is estimated as about 0.15 times 10 to the 9th power bacteria/liter/hour and total mortality is about 0.016/hour. Grazing accounts for about 56% of the total mortality process. (Author's abstract)
W88-04129

SPATIO-TEMPORAL VARIABILITY OF CHAETOZONE SETOSA (MALMGREN) POPULATIONS ON AN ORGANIC GRADIENT IN THE BAY OF BREST, FRANCE,
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
For primary bibliographic entry see Field 2L.
W88-04167

EFFECT OF WATER FLOW ON GROWTH AND REPRODUCTION OF CELLEPORELLA HYALINA (L.) (BRYOZOA:CHEILOSTOMATA),
University Coll. of North Wales, Bangor. School of Animal Biology.
J. M. Cancino, and R. N. Hughes.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 112, No. 2, p 109-130, October 27, 1987. 12 fig, 4 tab, 34 ref.

Descriptors: *Water flow, *Population dynamics, *Celleporella hyalina, Bioassays, Ecology, Growth rate, Autozoids, Zooids, Physiology, Bryozoans.

Colonies of Celleporella hyalina (L.), settled on glass petri dishes, were grown in the Menai Straits. Water flow over the colonies was either unrestricted or increasingly restricted by short and long funnels fitted over the petri dishes. Under all conditions, colonies grew exponentially for the first few weeks, but then growth decelerated. Growth rate at standard size was minimal in winter (December-February). Restricted water flow enhanced growth during winter but retarded growth at other times. Colonies began sexual reproduction at a size of approximately 57 autozooids, but at different ages depending on growth conditions. When colonies had accumulated 1000-2000 autozooids, the number of reproductive zooids (males plus females) per autozooid became asymtotic in the ratio of 1.0:2.0:3.6 in conditions of restricted, semirestricted, and unrestricted water flow, respectively. The proportion of sexual zooids that were reproductively active was greater among colonies experiencing greater water flow and, for all treatments, was greatest in June and least in winter. The experimentally induced trends in growth and reproduction were reversed by translocating colonies from one regime of water flow to another. Colonies had lower budding rates when grown close to neighboring colonies than when isolated, but the ratio of reproductive zooids to autozooids was similar in both treatments. Ratios of female to male zooids varied among colonies but with no clear relation to the experimental conditions, suggesting that relative investments in male and female functions are largely under genetic control. The life history of C. hyalina is well-suited to the ephemeral frondal tissue of Laminaria saccharina L. (Lamour), commonly used as a substratum in British waters. Early sexual maturity and sexual activity, concurrent with somatic growth, maximize average sexual output in the circumstances of unpredictable longevity. (Author's abstract)
W88-04171

POSSIBLE MECHANISMS UNDERLYING COPEPOD GRAZING RESPONSES TO LEVELS OF TOXICITY IN RED TIDE DINOFLAGELLATES,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W88-04172

COMMUNITY RESOURCE MANAGEMENT IN A TROPICAL WATERSHED - A CASE STUDY,
D. B. Zoleta.
Journal '86. World Resources Institute, pp 73-82, 1986. 14 ref.

Descriptors: *Resources management, *Watersheds, *Case studies, *Philippines, *Buhi watershed, Land use, Ecological effects, Management planning, Water resources development.

Upland and watershed areas have long been seen as reserves for growing populations and as development frontiers. As a result, in many tropical countries, the exploitation is destabilizing watershed-production systems. In the Philippines, one million hectares of watershed is now degraded. Land use effects on the watershed, lake use effects on lake resources, and a watershed management plan are highlighted in this discussion. The 15 elements of the community resource management and development plan are: (1) An appraisal of the resource endowments and limitations of the watershed; (2) An analysis of human population dynamics; (3) An appraisal and analysis of local people's uses of and demands on the watershed; (4) An appraisal and analysis of outside groups' demands on the lake and the watershed; (5) An analysis of the conflicting demands and uses of the watershed; (6) An appraisal, analysis, and ranking of the problems besetting the area; (7) An analysis of the impacts of these problems on the watershed and lake over time; (8) An appraisal and ranking of possible solutions that could solve the area's problems; (9) A thorough understanding of the legal, institutional, social, economic, political, and cultural scenarios in the watershed; (10) An assessment of the potentials or prospects for developing the lake and watershed; (11) An appraisal of feasible practical programs and activities that could complement each other; (12) An appraisal of local people's and other resource users' willingness to cooperate and affect changes in the watershed; (13) An appraisal of local government's efforts and willingness to initiate, cooperate, and bring about constructive changes; (14) An appraisal of the influences of regional and national policy-makers and the identification of ways to maximize these efforts through cooperation; and (15) An appraisal of the benefits and possible problems that would result if the watershed and lake resources were developed. (Lantz-PTT)
W88-04176

BASIN SCALE MODEL OF SOLUTE TRANSPORT,
Padua Univ. (Italy). Ist. di Idraulica.
For primary bibliographic entry see Field 2K.
W88-04188

BENTHIC COMMUNITY STRUCTURE AND COMPOSITION AMONG ROCKY HABITATS IN THE GREAT LAKES AND KEUKA LAKE, NEW YORK,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. H. Winnell, and D. J. Jude.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 3-17, 1987. 4 fig, 4 tab, 38 ref. NOAA Grant No. NOAA 80-D-00072.

Descriptors: *Great Lakes, *Benthic environment, *Ecosystems, Benthic fauna, Invertebrates, Lakes.

Benthic invertebrates were collected from 12 rocky sites in Lake Michigan, Lake Superior, and Keuka Lake, New York. Proportionate abundances of benthic components occurring in rock scrape (131 spp.) and pumped (167 spp.) samples (190 spp. total) were compared using coefficient of community (CC) and percent similarity of community (PSc). Pumped samples were judged better estimators of benthic community structure and composition than were rock scrape samples because they more thoroughly and instantaneously sampled the benthos. Rock scrape samples in particular were subject to loss of Amphipoda. Comparisons among sites using CC, PSc, and cluster analysis indicated two major clusters of sites, one dominated by Chironomidae and the other dominated for the most part by the amphipod Hyalella azteca. No water chemistry differences of biological importance were noted during the fall and no biological interactions, such as fish predation, could explain observed benthic community differences. The factor which best accounted for differences in the benthic community among sites was physical characteristics such as water temperature, shelter from excessive wave activity, and rock configuration. However, despite differences, the most remarkable feature among rock sites was their similarity since dominant taxa of Amphipoda, Chironomidae, Acarina, and to some extent Naididae, were quite predictable, although rank order of dominance changed from site to site. Similarity among sites was attributed to similar trophic conditions, while dissimilarity was attributed to physical characteristics acting within and upon each site. (Author's abstract)
W88-04203

DISTRIBUTION OF PHOTOSYNTHETIC PIGMENTS IN NEARSHORE SEDIMENTS OF LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, and M. A. Quigley.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 37-42, 1987. 2 fig, 2 tab, 32 ref.

Descriptors: *Photosynthetic pigments, *Lake Michigan, *Lake sediments, Detritus, Chemical analysis, Pigments, Seasonal variation, Chlorophyll a, Invertebrates.

To characterize nearshore detrital deposits and to identify potential input sources, photosynthetic pigments were examined in sediment cores taken from three stations in nearshore Lake Michigan between May and October 1979. Two stations were located at 11 m and one was at 23-m depth. At the 11-m stations, total pigment concentrations in the upper 0-1 cm layer were greatest in May and then declined, while seasonal changes at the 23-m station were not apparent. A high proportion of the spring influx of pigment at the 11-m depth was undegraded, indicating freshly settled material from the water column as a likely source. Sediment chlorophyll concentrations in the spring were as high as 212 micrograms/gm, but typical summer values were 1-7 nanograms/gm. Although these pelagic inputs are temporary, strong links exist between this material and benthic invertebrate distributions. (Author's abstract)
W88-04206

PHYTOPLANKTON COMPOSITION, ABUNDANCE, AND DISTRIBUTION: NEARSHORE

LAKE ONTARIO AND OSWEGO RIVER AND HARBOR,
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
J. C. Makarewicz.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 56-64, 1987. 3 fig, 4 tab, 27 ref.

Descriptors: *Phytoplankton, *Oswego River, *Lake Ontario, *Population density, Seasonal variation, Shores, Species diversity, Coastal waters, Chlorides, Diatoms.

Phytoplankton samples were collected during July, August, and October of 1981 from 16 stations located in the nearshore of Lake Ontario and in the Oswego Harbor and river. Phytoplankton assemblages represented many species widely recognized as associated with eutrophic environments and environments possessing high chloride levels. Picoplankton and diatoms were the dominant groups on a numerical and biovolume basis, respectively. The eutrophic species Stephanodicus tenis, Fragilaria capucina, and Scenedesmus spp. were present in the Oswego Harbor and river with substantially higher abundances than in the nearshore region of Lake Ontario. A decrease in abundance of the historically prevalent Asterionella and Tabellaria and an increase in cryptomonads is suggested for the Oswego area. Halophilic species dominated the diatom assemblage of the Oswego Harbor and mouth of the Oswego River. The abundance of halophilic species was correlated with high conductivity and chloride levels. Cyclotella atomus, C. cryptica, and C. meneghiniana, the dominant halophilic species at the harbor and river stations, accounted for 36.6% of the total diatom abundance. (Author's abstract)
W88-04208

FACTORS CONTRIBUTING TO DEVELOPMENT OF FRAGILARIA CRONTONENSIS KITTON PULSES IN PIGEON BAY WATERS OF WESTERN LAKE ERIE,
Windsor Univ. (Ontario). Dept. of Biology.
J. H. Hartig.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 65-77, 1987. 6 fig, 1 tab, 39 ref.

Descriptors: *Fragilaria crontonensis, *Population dynamics, *Lake Erie, *Pigeon Bay, Seasonal variation, Water temperature, Light penetration, Stratification, Nutrient mixing, Turbidity, Phosphorus, Silica, Population growth, Surface winds.

The factors which have contributed to the anomalous, large, summer Fragilaria crontonensis pulses in Pigeon Bay were investigated in experiments designed to study the effects of nutrients and the interaction of light and nutrients on growth, by field monitoring, and a review of published studies. Summer not only provides optimal water temperatures for F. crontonensis growth, but peak incident solar radiation ater transparency. It is hypothesized that F. crotonensis pulses during summer are dependent upon three major factors: (1) adequate supplies of nutrients (silica and phosphorus); (2) the presence of slight thermal stratification with concomitant wind velocities sufficient to keep cells circulating in the surface mixed layer; and (3) the presence of low turbidities with concomitant irradiance sufficient for growth. Once such physicochemical conditions exist, it appears that F. crontonensis can grow rapidly (because it is adapted to low light and is a superior exploitative competitor for phosphorus and silica) and achieve densities as high as 950,000 cells/L. Such pulses may be terminated by lack of wind (which allows cells to sink out of the photic zone), high wind velocities (which increase turbidity and decrease light penetration), or depletion of nutrients. Fragilaria crontonensis is probably not affected by zooplankton grazing because of its large size and chain-forming morphology. An order of magnitude increase in summer nitrogen:phosphorus ratios in Pigeon Bay since the late 1960s may have provided a more optimal environment for F. crontonensis growth in recent years. (Author's abstract)
W88-04209

OBSERVATIONS OF HYDRA FROM A SUBMERSIBLE AT TWO DEEPWATER SITES IN LAKE SUPERIOR,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, C. C. Remsen, and J. V. Klump.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 84-87, 1987. 4 fig, 21 ref.

Descriptors: *Hydra, *Lake Superior, *Deep water, Sandstone, Benthos, Species diversity, Plankton.

During a series of submersible dives at depths of 300 m and 400 m in southern Lake Superior, Hydra were observed attached to a variety of hard substrates including individual rocks, the edges of large boulders, and the undersurfaces of sandstone ledges. Although widespread, populations were generally found in distinct clumps. Based strictly on morphological features, the species resembled H. littoralis or H. carnea. The finding of Hydra at depths of 400 m in Lake Superior, the deepest sounding in the Great Lakes, would indicate that Hydra are not limited by depth provided there are hard substrates available for attachment and an adequate number of prey organisms. (Lantz-PTT)
W88-04211

DYNAMICS OF LAKE MICHIGAN PHYTOPLANKTON: MECHANISMS CONTROLLING EPILIMNETIC COMMUNITIES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, and G. L. Fahnenstiel.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 103-120, 1987. 9 fig, 3 tab, 84 ref.

Descriptors: *Limnology, *Lake Michigan, *Phytoplankton, *Ecosystems, *Epilimnion, Algae, Organic carbon, Sedimentation, Zooplankton, Diatoms, Population dynamics.

Lake Michigan epilimnetic algal and particulate organic carbon sedimentation rates, determined from moored and floating sediment traps, and algal loss rates due to crustacean zooplankton grazing, determined from manipulation experiments with natural assemblages, were estimated during 1983 and 1984 field seasons. Sedimentation was the most important algal loss in spring when colonial diatoms and calanoid copepods dominated the plankton. Grazing was the most important loss during summer when phytoflagellates and Daphnia spp. dominated. Comparisons between algal community production and loss due to sedimentation and grazing suggest that natural mortality may be significant, but it does not dominate control. It is hypothesized that the extent of the spring algal bloom should be predictable, based on winter concentration of available nutrients and on meteorological events influencing the timing of the onset of thermal stratification. It is further hypothesized that nutrient-controlled sedimentation is responsible for the major seasonal taxonomic shift among phytoplankton. While food web alterations have resulted in decreased summer epilimnetic phytoplankton concentration and production, they appear to have increased those properties below the thermocline. This shift of production to deeper in the water column places relatively more emphasis on production of larger cells, where direct energy transfer from primary producers to the large invertebrate prey of larval and adult fish can occur. (Lantz-PTT)
W88-04214

SEASONAL BATHYTHERMAL DISTRIBUTION OF JUVENILE LAKE TROUT IN LAKE ONTARIO,
Fish and Wildlife Service, Oswego, NY. Oswego Biological Station.
J. H. Elrod, and C. P. Schneider.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 121-134, 5 fig, 7 tab, 16 ref.

Descriptors: *Limnology, *Lake trout, *Trout, *Lake Ontario, *Population distribution, *Bathythermal distribution, Lake fisheries, Seasonal variation, Water temperature, Seneca Lake, Lake Superior, Thermal stratification, New York.

Bathythermal distributions of hatchery-reared lake trout of three genetic strains (Lake Superior; Clearwater Lake, Manitoba; and Seneca Lake, New York) were described from catches with bottom trawls in Lake Ontario during April-May, June, July-August, and October, 1978-1984. This work was part of a program to evaluate post-stocking performance of hatchery-reared fish and identify strains for continued use in rehabilitation of lake trout in Lake Ontario. All age groups of Lake Superior fish were in deeper water in April-May than in June each year; mean depth of capture was greatest at age II and became progressively shallower at ages III and IV. Mean depth of capture in April-May was positively correlated with severity of the preceding winter as judged by heating degree days and average wind speed. During July-August, the fish were concentrated between the epilimnion and 50 m, with no consistent trend in depth by age; however, 92% were captured at water temperatures of 12 C or lower. Mean temperatures of capture for Lake Superior fish during the four respective sampling periods were 3.9, 7.5, 6.9, and 9.5 C for fish of age II and 3.9, 8.4, 6.9, and 8.7 C for fish of age III. The age-II Clearwater Lake fish were consistently at shallower depths than age-II Lake Superior fish. Mean temperatures of capture were 4.2, 9.7, 9.6, and 10.7 C during the four respective sampling periods; during July-August, 91% were taken in water of 12 C or lower. The distributions of Seneca Lake fish was similar to that of the Lake Superior strain. Mean temperatures at which the three strains were captured were well below published preferred temperatures of yearlings in the laboratory. Annual variations in depth distribution during a given season were probably due to differing thermal regimes resulting from annual variations in the weather. (Author's abstract)
W88-04215

EFFECTS OF TEMPERATURE AND DENSITY ON SEDIMENT REWORKING BY STYLODRILUS HERINGIANUS (OLIGOCHAETA: LUMBRICULIDAE),
Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. S. White, P. C. Klahr, and J. A. Robbins.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 147-156, 1987. 4 fig, 4 tab, 35 ref. NSF Grant No. OCE-7825680.

Descriptors: *Water temperature, *Population density, *Lake sediments, *Worms, Population dynamics, Feeding rates.

A non-destructive, radio-marker system was used to follow sediment burial, or reworking rate, by the particle-feeding oligochaete Stylodrilus heringianus Claparede over a range of work densities and water temperatures in laboratory microcosms. Marker layer burial rates were monitored for seven densities (30,000 to 134,000 worms/sq m) while slowly altering the temperature from 10 C down to 4 C, up to 20 C, and then back to 10 C. From 10 C to 4 C, reworking rates decreased approximately 90%. When the temperature was increased above 4 C, reworking rates approached levels shown at the initial 10 C but remained relatively constant through the remainder of the experiment. It is assumed that reproductive activities, stimulated by the 4 C period, affected feeding activity. The reworking rate/worm was shown to be independent of the initial oligochaete density. Time dependent and depth dependent models were tested to examine the decline in observed reworking rates during the latter part of the experiment. There was a weak correlation between time and decreased reworking rates and a strong correlation between density and depth of feeding. Correlations suggested that reworking rates/worm remained similar over time, but the depth to which an organism fed increased with increasing worm density. (Author's abstract)
W88-04217

DISPERSAL OF THREE STRAINS OF HATCHERY-REARED LAKE TROUT IN LAKE ONTARIO,
Fish and Wildlife Service, Oswego, NY. Oswego Biological Station.
J. H. Elrod.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 157-167, 1987. 5 fig, 3 tab, 9 ref.

Descriptors: *Population density, *Lake trout, *Trout, *Lake Ontario, *Fish stocking, Species diversity, Fisheries, Lake fisheries, Lake Superior, Clearwater Lake, Seneca Lake, Fish populations, Dispersal, Fish management.

Rates of dispersal and resultant geographical distributions were determined for three strains of hatchery-reared lake trout (Salvelinus namaycush) stocked at six sites in U.S. waters of Lake Ontario. The strains were Lake Superior (SUP); Clearwater Lake, Manitoba (CWL); and Seneca Lake, New York (SEN). The fish were recovered with bottom trawls fished during July and August 1980-1985 at 16 locations, extending from Toronto southward and eastward along the south shore to Dablon Point at the east end of the lake. For SUP fish stocked as spring yearlings, the mean distances from stocking site to capture location 2, 14, and 26 months after stocking were 12, 57, and 62 km, respectively, for fish released at four south-shore sites and 5, 34, and 38 km for fish released at two eastern outlet basin sites. Rates of dispersal for the CWL fish were similar to those of the SUP strain for fish stocked at the four south-shore sites, but were considerably less for fish stocked in the eastern outlet basin. The SEN strain was stocked only in the eastern outlet basin; their dispersal was similar to that of the SUP strain. For fish of the same age, SUP fish stocked as full fingerlings became more widely dispersed than those stocked as spring yearlings. Movement of lake trout between the eastern outlet basin and the lake proper was limited. Large numbers of fish were captured on the Niagara Bar, but few moved past there into the west end of the lake. Movements of lake trout from stocking sites were generally with the prevailing currents. Differences between geographical distributions of the SUP and CWL strains were probably due to the influence of different current regimes at the depths they occupied. These results will be useful in selecting the best genetic strains of lake trout for rehabilitating the species in Lake Ontario, as well as for identifying the best stocking sizes and maximizing post-stocking survival of hatchery-reared fish. (Author's abstract)
W88-04218

SEASONAL MOVEMENTS AND HABITATS OF BROWN TROUT (SALMO TRUTTA) IN SOUTHCENTRAL LAKE ONTARIO,
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
D. C. Nettles, J. M. Haynes, R. A. Olson, and J. D. Winter.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 168-177, 1987. 4 fig, 2 tab, 38 ref. NOAA Grant Nos. 122-C003G, 122-7272A, and 122-S005G.

Descriptors: *Seasonal variation, *Trout, *Lake Ontario, Population density, Fish migration, Water temperature, Thermocline, Fish management.

During 1980-82 the movements, seasonal locations, and habitat preferences of brown trout in south-central Lake Ontario were examined using radio telemetry and vertical gill nets. In fall and spring 85% of the 28 brown trout tracked by radio moved east from tagging sites. Movements frequently centered around original stocking sites, streams, and power plant outflows. Fish moved farther in spring (4.4 + or - 2.5 km/d) than in fall (2.4 + or - 1.7 km/d) seasons, but short-term movement rates did not differ between seasons (0.4 + or - 0.1 km/h in spring vs. 0.4 + or - 0.3 km/h in fall). Females moved farther and faster than males in the fall. Brown trout generally occupied shallow waters < 1 km from shore; 81% of temperatures occupied by trout were between 8-18 C in spring (10.6 + or - 2.3 C) and fall (10.1 + or - 3.9 C), but turbidity appeared to influence presence or absence of trout near shore on a daily basis. In summer 78% of the 75 brown trout netted were in 8-18 C water (12.6 + or - 4.0 C); 88% were caught in or within + or - 3 m of the thermocline region. Brown trout occupied regions near the thermocline despite widely varying bottom depths and thermocline temperatures. All brown trout were netted within 3.2 km of shore in summer, most in water < or = 30 m deep; 70% were caught more than 3 m off bottom. The strong association of brown trout with nearshore and thermocline regions may distinguish their distributions from other salmonid species in Lake Ontario. (Author's abstract)
W88-04219

ACID RAIN STIMULATION OF LAKE MICHIGAN PHYTOPLANKTON GROWTH,
Fish and Wildlife Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 5C.
W88-04223

EVIDENCE FOR THE LAKE CHIPPEWA EXTREME LOW-WATER STAGE IN LAKE MICHIGAN,
Northeastern Illinois Univ., Chicago. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2J.
W88-04224

CLASSIFICATION AND SUCCESSION OF FORMER CHANNELS OF THE FRENCH UPPER RHONE ALLUVIAL PLAIN USING MOLLUSCA,
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
M. Richardot-Coulet, E. Castella, and C. Castella.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 111-127, April-June 1987. 7 fig, 7 tab, 26 ref.

Descriptors: *Alluvial plains, *Channels, *Mollusks, *Rhone River, *Ain River, France, Aquatic environment, Population distribution, Species diversity, Classification, Eutrophication.

An extensive sampling program of eight former channels of the Rhone and eight of its tributary, the Ain River, France, was designed to assess the value of mollusks as 'describers' of ecosystem dynamics. The sampling was stratified on the distribution of aquatic macrophytes. The distribution of mollusk species provides information on the rate of eutrophication, the groundwater supply and the succession of the abandoned river channels toward semi-aquatic and terrestrial conditions. Mollusks, together with other macroinvertebrates, not only describe the present stage of these ecosystems but also provide some predictive information on their successional pattern for assistance in the management of the alluvial plain. The presence of Bathyomphalus contortus and Pisidium millium indicates the occurrence of an important groundwater supply while the two Pisidium species, P. moitessierianum and P. subtruncatum var. indicate surface water exchanges with that revealed by other describers, permits the identification of the main phenomenon involved in the functioning of hydrosystems. (Author's abstract)
W88-04226

STREAM REGULATION IN ARGENTINA, INCLUDING THE SUPERIOR PARANA AND PARAGUAY RIVERS,
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina).
For primary bibliographic entry see Field 6G.
W88-04227

EFFECTS OF TRANSFERRING GLACIER-FED WATER TO A CLEAR-WATER MOUNTAIN RIVER ON THE PRODUCTION AND FOOD ORGANISMS OF BROWN TROUT (SALMO TRUTTA L.) IN SOUTHERN NORWAY,
Direktoratet for Vilt og Ferskvannsfisk, Aas (Norway). Fish Research Div.
For primary bibliographic entry see Field 6G.
W88-04229

ECOLOGICAL CONSIDERATIONS IN THE DEVELOPMENT AND APPLICATION OF INSTREAM FLOW-HABITAT MODELS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2E.
W88-04230

SEDIMENT DESORPTION OF PCB CONGENERS AND THEIR BIO-UPTAKE BY DIPTERAN LARVAE,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5B.
W88-04247

HYPOLIMNETIC WITHDRAWAL IN TWO NORTH AMERICAN LAKES WITH ANOXIC PHOSPHORUS RELEASE FROM THE SEDIMENT,
York Univ., Downsview (Ontario). Faculty of Science.
For primary bibliographic entry see Field 5G.
W88-04254

PRELIMINARY STUDY OF THE EFFECTS OF DRAINAGE AND HARVESTING ON WATER QUALITY IN OMBROTROPHIC BOGS NEAR SEPT-ILES, QUEBEC,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W88-04278

ASSESSING FLUSHING-FLOW REQUIREMENTS FOR BROWN TROUT SPAWNING GRAVELS IN STEEP STREAMS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-04297

OPTICAL HETEROGENEITY IN GREEN BAY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and M. T. Auer.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 937-941, October 1987. 5 fig, 24 ref. U.S. EPA Grants R809521010 and R810076010.

Descriptors: *Optical properties, *Water quality, *Lakes, *Green Bay, Optical heterogeneity, Water properties, Water quality control, Light penetration, Light attenuation, Transparency, Color, Water quality management, Turbidity.

Differences in light penetration and light attenuation components and processes are documented along 112 km of the major (NE/SW) axis of Green Bay (Lake Michigan) during a three-day cruise (May 25-27, 1982). Measurements included diffuse attenuation of downwelling irradiance (k sub d), Secchi disk transparency (SD), phytoplankton pigments (chlorophyll a and phaeophytin), turbidity (T sub n), sorption and dissolved color (absorbance). The relative importance of absorption and scattering to attenuation was calculated from paired measurements of k sub d and SD. Absorption and scattering coefficients were calculated; value estimates were supported by a strong linear relationship between the scattering coefficient (b) and T sub n (b = 0.99 *T sub n; r squared = 0.97, n = 12). Light attenuation characteristics, including the extent of light penetration and the magnitudes and relative importance of absorption, scattering and individual attenuating components, were found to be heterogeneous in space. This heterogeneity is due to the characteristics and positions of entry of fluvial discharges to the bay as they influence levels of dissolved color (Gelbstoff), phytoplankton standing crop, and inorganic particulates. Identification of key processes regulating light penetration and their potential for response to pollution control measures can aid in the development of a water quality management plan for Green Bay. (Author's abstract)
W88-04298

EFFECTS OF OXYGEN TRANSPORT ON THE AREAL HYPOLIMNETIC OXYGEN DEFICIT,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1887-1892, October 1987. 5 fig, 4 tab, 24 ref. USEPA Grants 5P2-WP 184-04 and 16010-EHR.

Descriptors: *Oxygen transfer, *Wisconsin, *Eutrophic lakes, *Lakes, *Oxygen deficit, Lake Mendota, Lake Delavan, Seasonal variation, Statistical analysis, Hypolimnion, Epilimnion, Primary productivity, Dissolved oxygen.

Using a modified flux gradient technique, transmetalimnetic oxygen transport was evaluated in Lakes Mendota and Delavan, two eutrophic Wisconsin basins featuring moderate depth ($17 < z_{sub\ max} < 25$ m), good wind exposure, and classic clinograde oxygen profiles. The biweekly fluxes intensified between mid-May and late-July 1972, mainly on account of seasonal steepening of the metalimnetic O2 gradients. Fluxes also increased sharply during windy intervals characterized by accelerated transmetalimnetic heat fluxes. The fluxes across the lower epilimnetic boundary exceed those across the lower metalimnetic boundary; this differential is consistent with the metalimnion's role as an oxidation zone in these turbid lakes. The vertical fluxes are a large but variable (over time) fraction of the net areal oxygen deficit in both lakes, complicating statistical analysis of seasonal and intergenerational trends in lake productivity using the areal hypolimnetic oxygen deficit method. Even after correcting for the effects of O2 transport, the deficit in Lake Mendota exceeds that in Delavan following the onset of hypolimnetic anoxia in the shallower lake. This difference likely results, in part, from transmetalimnetic fluxes of reducing substances (CH4, NH3, etc.) into the epilimnion. (Author's abstract)
W88-04309

SIMULATION MODEL FOR OIL SLICK TRANSPORT IN LAKES,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-04316

ANALYSIS OF NITRATE IN ENVIRONMENTAL SAMPLES BY REVERSED-PHASE HPLC,
Emporia State Univ., KS. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-04331

DETERMINATION OF TRACE METALS IN NATURAL WATERS AT NANOGRAM PER LITER LEVELS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY AFTER EXTRACTION WITH SODIUM DIETHYLDITHIOCARBAMATE,
Jadavpur Univ., Calcutta (India). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-04332

MAPPING AND RISK ASSESSMENT OF OXYGEN CONSUMPTION BY SEDIMENTS IN THE LOWER ELBE (KARTIERUNG UND RISIKOBETRACHTUNG DER SAUERSTOFFZEHRUNG VON SEDIMENTEN DER UNTERELBE),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W88-04352

LAKE EUTROPHICATION MANAGEMENT MODEL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 5G.
W88-04356

THERMAL CHANGES IN LAKE SUPERIOR STORAGE IN 1976,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. A. Assel.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 1177-1181, September 1987. 2 tab, 6 ref.

Descriptors: *Thermal stratification, *Lake Superior, *Water temperature, Seasonal variation, Mathematical analysis.

Thermal change in lake storage between beginning-of-month (BOM) dates was calculated from joint volumetric and mass balances. Thermal change in storage was important in May and July because published data indicate no change in lake storage during these months in 1976. For the remaining months, thermal change in storage peaked during the period of thermal stratification, when it accounted for > 10% of the change in storage. Thermal corrections to net basin supply (NBS) ranged from 30% to > 100% when the NBS was < 400 cu m/s; thermal corrections to NBS when > 400 cu m/s were between 1% and 30%, and they averaged 8.5%. An analysis indicated that a 0.4 C error along the entire BOM temperature profile yielded an average error of 27% in the monthly thermal change in storage. (Author's abstract)
W88-04406

COMPARATIVE ANALYSIS OF IRON, MANGANESE, SILICA, PHOSPHORUS, AND SULFUR IN THE HYPOLIMNIA OF CALCAREOUS LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Water Research WATRAG, Vol. 21, No. 9, p 1009-1022, September, 1987. 5 fig, 7 tab, 80 ref. U. S. EPA Grant R805281.

Descriptors: *Lakes, *Metals, *Nutrients, *Hypolimnion, *Wisconsin, *Chemical reactions, *Limnology, Comparison studies, Iron, Manganese, Silica, Phosphorus, Sulfur, Cycling nutrients, Chemical properties, Limiting nutrients, Diatoms, Eddies, Dissolved oxygen, Path of pollutants.

The chemistry of the hypolimnion was studied in late summer in 23 individual basins of 19 calcareous lakes situated in the Midwestern U.S.A. The basins represented a broad range in morphometry, and drainage basin influences. All but two of the basins were anoxic by early September. The concentrations of Fe were low in the anoxic basins because of precipitation of FeS. Excess sulfide accumulated in the hypolimnion (up to 7 milligrams/liter) making these basins sulfuretums. The concentrations of total-P ranged widely - from 0.03 milligrams/liter in several seepage lakes to >0.5 milligrams/liter in drainage lakes with very short hydraulic residence times, or influenced by agricultural or urban drainage, or municipal waste. Neither apatite nor vivianite limited the hypolimnetic build-up of this key nutrient. Hypolimnetic Mn was almost entirely soluble if the basin was anoxic. The concentrations indirectly reflected external inputs, not the thermodynamics of rhodochrosite. Concentrations of dissolved silica were generally much lower than in inflowing waters. The hypolimnetic Si/P ratio was low unless the lake lacked surface inflows and also experienced high rates of groundwater inflow rich in silica and very low in P. Because of the very low hypolimnetic Fe/P and Fe/Si ratios, phosphate and silica are liberated from significant chemical interactions with Fe accompanying their eddy diffusion transport upward within the hypolimnion, and across the metalimnetic oxycline. Because of external P inputs and the efficiency of internal P recycling, Si is potentially a limiting nutrient for diatoms in calcareous lakes. (Author's abstract)
W88-04440

GRAPHIC ESTIMATION OF PEAK FLOW REDUCTION IN RESERVOIRS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04459

MODAL RESPONSE OF RESERVOIRS TO WIND STRESS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04465

CHARACTERISTICS OF SESTON IN A REGULATED APPALACHIAN MOUNTAIN RIVER, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. F. Kazmierczak, J. R. Webster, and E. F. Benfield.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 4, p 287-300, December 1987. 5 fig, 4 tab, 38 ref.

Descriptors: *Seston, *Rivers, *New River, *Virginia, River flow, Aquatic drift, Particle size, Settling velocity, Regulated flow, Organic matter.

Six size classes of seston were collected seasonally from the New River, Virginia, during three flow regimes: low flow, discharge changes resulting from daily cycles of hydroelectric power generation, and naturally occurring storm discharge cycles. Seston concentration and particle shape, density, and settling velocity were measured for all size classes, seasons, and flow regimes. Seston concentration, density, and settling velocity varied significantly with size class, season, and flow regime. Total concentrations ranged from a low of 0.47 mg/L during autumn base-flow to a high of 92.6 mg/L during a winter storm. Mean seston densities ranged between 1.60 and 2.02 gm/cm, which is much lower than previously published measurements for rivers, suggesting that seston in the New River may be mainly organic-inorganic aggregates. Mean seston settling velocity was lowest during low-flow and hydroelectric discharges (0.10 cm/sec) and highest during storms (0.19 cm/sec). Seston particle shape varied significantly only with size class. The inability of a commonly used transport equation to predict transport during most discharge conditions suggests that, in some systems, seston concentration and transport may be less a function of discharge and power than of long-term seasonal and short-term discharge cycle effects on the density and size characteristics of seston. (Author's abstract)
W88-04473

IMPORTANCE FOR BIRDS OF THE RIPARIAN WOODLANDS WITHIN THE ALLUVIAL CORRIDOR OF THE RIVER GARONNE, S.W. FRANCE,
Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
H. Decamps, J. Joachim, and J. Lauga.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 4, p 301-316, December 1987. 9 fig, 5 tab, 41 ref.

Descriptors: *Riparian vegetation, *Birds, *Garonne River, *France, Forests, Statistical analysis.

Communities of nesting birds were studied in four distinct biotopes within the alluvial corridor of the River Garonne: 50 terrace woodlands, 17 riparian woodlands, one poplar plantation, and one slope woodland. A total of 400 stations were investigated, consisting of eight distinct classes of forest size for the terrace woodlands and four for the riparian woodlands. The distribution of 64 species of birds, observed by means of 20 minute listening point surveys, was related to three main factors: forest size, site wetness, and the wooded space marginality (forests, woods, copses, hedges, trees). Indices of mean richness and of mean abundance show that the riparian woodlands were the richest and the most densely populated. The surface area of woodlands has a strong effect on the structure of the bird community on terraces but less in the riparian environment. Multivariate analysis contrasted the species from the open islands within closed environments with the species from the closed islands within an open environment. The effect upon the nesting bird communities of the fragmentation of the original forest within the alluvial corridor of

the River Garonne is demonstrated by a grouping of two characteristics: the connectivity of the riparian woodlands and the insularity of the terrace woodlands. The conservation of a continuous ribbon of riparian woodlands is an important condition for maintaining a rich community of nesting birds. (Author's abstract)
W88-04474

2I. Water In Plants

EFFECTS OF DROUGHT ON PRIMARY PHOTOSYNTHETIC PROCESSES OF COTTON LEAVES,
Paris-7 Univ. (France). Lab d'Ecologie Generale et Appliquee.
B. Genty, J. M. Briantais, and J. B. Vieira Da Silva.
Plant Physiology PLPHAY, Vol. 83, No. 2, p 360-364, February 1987. 4 tab, 27 ref.

Descriptors: *Drought, *Photosynthesis, *Leaves, *Cotton, *Soil-water-plant relationships, *Plant physiology, *Water stress, Fluorescence, Stress, Temperature effects, Light intensity, Water potentials, Plant tissues.

The effects of drought on photosystem II (PSII) fluorescence and photosynthetic electron transport activities were analyzed in cotton. Water stress did not modify the amplitude of leaf variable fluorescence at room temperature in the presence of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU) nor at 77 K. Therefore, photon collection, their distribution between the two photosystems, and PSII photochemistry were unaffected by the stress. In droughted leaves at room temperature under low exciting light, the transitory maximum (F sub p) and steady state (F sub t) fluorescence levels were increased; under high exciting light, F sub p level and the rise time from the initial level (F sub o) to F sub p were unchanged, whereas F sub p to F sub t decay time was increased. These results infer that the drought slowed the rate of plastoquinone reoxidation. This conclusion agrees with the larger proportion of reduced primary PSII electron acceptor Q sub A measured at the steady state under low light. In thylakoids isolated from drought leaves, PSII mediated electron flow was the same as in thylakoids from control leaves, whereas PSI mediated electron transport was inhibited. It was shown that water stress did not induce sensitization to photoinhibition in cotton. (Author's abstract)
W88-03592

ALTERATION OF CELL-WALL WATER CONTENT AND ELASTICITY IN DOUGLAS-FIR DURING PERIODS OF WATER DEFICIT,
Oregon State Univ., Corvallis. Dept. of Forest Science.
R. J. Joly, and J. B. Zaerr.
Plant Physiology PLPHAY, Vol. 83, No. 2, p 418-422, February 1987. 3 fig, 15 ref.

Descriptors: *Douglas-fir, *Moisture content, *Water deficit, *Plant physiology, *Elastic properties, *Osmotic pressure, *Cell-wall water, Drought effects, Trees, Seedlings, Osmosis, Turgidity, Plant water potential, Water potentials, Vascular tissues.

Three populations of Douglas-fir seedlings were subjected to recurrent drought cycles. Pressure-volume curves were developed to derive the osmotic and pressure potentials as functions of the symplastic water over a wide range of relative water content. The drought cycles induced large reversible changes in the relative water content of the apoplasm and in the bulk modulus of elasticity. These responses have not been reported previously in any species of higher plant. Data suggest that turgor regulation in Douglas-fir is mediated by structural and biochemical factors associated with the cell wall, rather than by osmotic adjustment. (Author's abstract)
W88-03593

EFFECT OF AN INTERMITTENT WATER-TABLE GRADIENT ON SOIL AND XYLEM NITRATE IN COTTON,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
N. L. Schaefer, F. M. Melhuish, D. C. Reicosky, and W. S. Meyer.
Plant and Soil, PLSOA2, Vol. 97, p 71-77, January 1987. 2 fig, 2 tab, 11 ref.

Descriptors: *Soil-water-plant relationships, *Waterlogging, *Nitrates, *Soil water table, *Soil water, *Denitrification, Xylem, Flooding, Cotton, Gossypium, Irrigation, Water table, Soil solution, Carbon substrate.

Cotton was grown in a sloping plot of soil in the field in order to examine the effect of a gradient of water-table depth on soil nitrate availability and plant uptake during two periods of the growing season. Before the water-table was imposed NO3 was less concentrated at the lower end which was wetter than further up the plot. At flooding NO3 disappeared only slowly due to a carbon substrate limitation to dentrification in the soil. This loss occured primarily in areas where the water-table was high and oxygen concentration in the xylem, paralleled the distribution of NO3 in the soil solution. Under high water-tables xylem NO3 levels fell but it was not possible to say whether this was due to impaired root function or to the reduced concentration of NO3 observed in the soil solution. At intermediate water-table depths where soil NO3 availability remained high xylem NO3 concentration fell relative to the well drained control plants, suggesting that flooding had damaged the root system. (Author's abstract)
W88-03659

PLANT WATER POTENTIAL MEASURED CONTINUOUSLY IN THE FIELD,
National Vegetable Research Station, Wellsbourne (England).
For primary bibliographic entry see Field 2D.
W88-03660

EFFECTS OF SALINITY AND VARYING BORON CONCENTRATIONS ON BORON UPTAKE AND GROWTH OF WHEAT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W88-03661

GAS COMPOSITION AND RESPIRATION OF WATER OAK (QUERCUS NIGRA L.) AND GREEN ASH (FRAXINUS PENNSYLVANICA MARSH.) ROOTS AFTER PROLONGED FLOODING,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
B. J. Good, and W. H. Patrick Jr.
Plant and Soil PLSOA2, Vol. 97, No. 3, p 419-427, March 1987. 5 tab, 26 ref.

Descriptors: *Water logging, *Flooding, *Plant growth, *Plant water potential, *Soil water, Water oak, Oak, Quercus, Green ash, Fraxinus, Roots, Flood irrigation, Irrigation.

The eefects of 9.5 months of a continuous flooding treatment was compared with a drained control treatment on one year-old seedlings of green ash (Fraxinus pennsylvanica Marsh.) and water oak (Quercus nigra L.), two tree species common to the bottom-land hardwood forests of eastern North America. The internal root gass composition of the more flood tolerant species, green ash, maintained higher oxygen and lower carbon dioxide concentrations under the flooding treatment than water oak. This apparently resulted in differences in rhizosphere oxidation. The amounts of Fe and Mn and the Fe/Mn ratio of the root coating extracted from trees in reduced soil conditions were much higher for the green ash than the water oak. It is argued that this reflects differences in the capability of these two species to maintain rhizosphere oxidation under prolonged periods of flooding and to prevent the accumulation of reduced potentially phytotoxic compounds. Alchohol dehydrogenase activity increased in the green ash and decreased in the water oak in the flooded treatment. This indicated that the better adapted species was able to rely upon increased anaerobic respiration in order to compensate for the decreased root oxygen supply, but the water oak was unable to maintain previous levels of respiration, probably as the result of sulfide toxicity. (Author's abstract)
W88-03662

SALT INCREASES THE WATER USE EFFICIENCY IN WATER STRESSED PLANTS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 3C.
W88-03751

INFLUENCE OF PRESTRESS ENVIRONMENT ON ANNUAL BLUEGRASS HEAT TOLERANCE,
Illinois Univ. at Urbana-Champaign. Dept. of Horticulture.
D. L. Martin, and D. J. Wehner.
Crop Science CRPSAY, Vol. 27, No., p 579-585, May-June 1987. 4 fig, 2 tab, 14 ref. Univ. of Illinois project 65-356.

Descriptors: *Temperature effects, *Heat stress, *Heat tolerance, *Bluegrass, *Soil water, Rainfall, Irrigation, Plant water use, Monitoring, Roots.

Annual bluegrass (Poa annua L.) turf quality is reduced during periods of high temperature. To predict heat stress injury and develop improved prestress maintenance practices, an understanding of the seasonal variation in annual bluegrass heat tolerance and the influence of soil moisture on heat tolerance is crucial. Annual bluegrass growing in the field on a Drummer silty clay loam (fine silty, mixed, mesic Typic Haplaquolls) was sampled on 23 dates over two growing seasons and brought to a laboratory for exposure to high temperature. Prestress environmental conditions (air and soil temperature, soil matric potential, plant water potential, daylength, rainfall and irrigation) were monitored. Plants were enclosed in plastic bags, exposed for 30 min to temperatures in the range 40 to 48 C in a water bath and placed in a greenhouse for a 2-week recovery period. The dry weight of the stressed plants expressed as a percentage of the controls (heat tolerance indices, HTI) was used as a measure of heat tolerance. In a second experiment, field plots of annual bluegrass were maintained for one growing season under either a dry (rainfall plus irrigation to prevent severe wilting) or moist (dry treatment plus 10-mm irrigation every other day) soil regime. Plants were stress-tested on five dates when differences in soil matric potentials existed between treatments, and on five dates when matric potentials were identical (saturated soil). Turfgrass color, quality, and rooting depth were monitored. The second experiment revealed a nonsignificant trend for annual bluegrass maintained under moist soil conditions to be less heat tolerant than that under dry conditions. No differences were found due to treatment in rooting depth which negatively correlated ($r = -0.83$) with the soil temperature at 10 cm. Because of reduced turfgrass quality with the dry soil conditions, there appeared to be little potential for increasing heat tolerance through irrigation management. (Author's abstract)
W88-03752

SUPERBUGS SPRING FROM HOT WATER,
Waikato Univ., Hamilton (New Zealand).
For primary bibliographic entry see Field 2H.
W88-03818

RAPID AMMONIUM UPTAKE AND NITROGEN INTERACTIONS IN FIVE INTERTIDAL SEAWEEDS GROWN UNDER FIELD CONDITIONS,
British Columbia Univ., Vancouver. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W88-03837

TURBULENCE SPECTRA OF CO2, WATER VAPOR, TEMPERATURE AND VELOCITY OVER A DECIDUOUS FOREST,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
D. E. Anderson, S. B. Verma, R. J. Clement, D. D. Baldocchi, and D. R. Matt.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 81-99, October 1986. 10 fig, 2 tab, 23 ref. NSF grant No. ATM-8205431.

Descriptors: *Turbulence spectra, *Carbon dioxide, *Humidity, *Forest canopy, *Water vapor, Canopy, Temperature.

Forest canopy occupies a significant portion of the earth's total land area. A through understanding of the mechanisms of turbulent transfer between the forest and the atmosphere requires information on turbulence spectra. Although turbulence spectra have been measured for a number of years over a variety of surfaces, very few studies have been conducted on spectra of turbulent fluctuations (particularly on humidity and CO2 concentration) over the forest canopy. Information on turbulence spectra was derived from measurements made with an instrument array including a prototype rapid-response CO2 sensor over a deciduous forest on complex terrain near Oak Ridge, TN.. When compared to measurements from previous studies over flat terrain, velocity spectra appeared to be shifted toward lower frequencies. This tendency was especially apparent in lateral and vertical spectra. Peaks occurred around f = 0.035-0.07 (where f is the non-dimensional frequency) in all spectra measured under neutral conditions, except for vertical velocity which had a peak near f = 0.16. Cospectra of sensible heat, water vapor and CO2 measured during neutral conditions were similar in shape and had peak frequencies near f = 0.10 - 0.15. As thermal stability changed from near neutral to unstable conditions the spectral peaks generally shifted toward lower frequencies. (Ray-PTT) W88-03874

INTERACTIVE EFFECTS OF WATER AND NITROGEN STRESSES ON CARBON AND WATER VAPOR EXCHANGE OF CORN CANOPIES,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
J. W.. Jones, B. Zur, and J. M. Bennett.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 113-126, October 1986. 8 fig, 1 tab, 26 ref.

Descriptors: *Water stress, *Nitrogen stress, *Corn yield, *Canopy, Evapotranspiration, *Photosynthesis, *Vapor pressure deficit, Crop yield, Water use efficiency.

Water and nitrogen stress often reduce the yield of corn. Crop response to low soil nitrogen are similar in many ways to crop responses to soil water dificits. Interaction between nitrogen and water stresses is also common. The objective of this study was to examine the interactive effects of water and nitrogen stresses on canopy photosynthesis, evapotranspiration, and water use efficiency of field corn canopies. Corn was grown on a kendric fine sand soil and subjected to three irrigation treatments (optimal, vegetative water stress,and rainfed). Two nitrogen levels were imposed within each irrigation treatment (low, 62 kg/ha; high, 255kg/ha). During the vegetative water stress period, hourly measurements were made of canopy carbon dioxide exchange rate (CER) and canopy evapotranspiration (ET) on the optimal and vegetative water stress treatment in combinations with both nitrogen levels. In addition to decreases in ET caused by water stress, the corn canopies exhibited a decrease in ET when subjected to nitrogen stress. Part of this decrease can be explained by the lower leaf area indexes (LAI) of the low-nitrogen canopies. On day 14 of the vetative water stress, a curvilinear relationship existed between CER and photosynthetic photon flux density (PPFD) for both the irrigated high- and low-nitrogen plants although low-nitrogen plants exhibited decreased sensitivity to PPFD during midday hours. In contrast, two distinctly different hysteretic loops were obtained for low- and high-nitrogen water stress plants. Instantaneous water use efficiency (CER/ET) varied considerably with time of day and treatment combination. Most of this variation was the result of different vapor pressure dificits (VPD). Canopy was linearly related to ET/VPD regardless of nitrogen and water stress and the slope of the line (k = 0.024) was in close agreement with the predicted theoretical values (Author's abstract)
W88-03875

INTERACTIONS OF WATER VARIABLES AND GROWING DEGREE DAYS ON HEADING PHASE OF WINTER WHEAT,
Agricultural Research Service, Bushland, TX.
D. J. Undersander, and S. Christiansen.
Agricultural and Forest Meteorology, Vol. 38, No. 1-3, p 169-180, October 1986. 7 tab, 20 ref.

Descriptors: *Growing degree days, *Wheat, *Irrigation, *Available water, *Heading, Regression analysis, Rainfall, Model studies, Crops, Temperature effects, Environmental variables.

The use of growing degree days (GDD) to estimate phenological development is well established. However, the interaction of water availability with degree days has not been well defined. Studies were conducted from 1968 to 1983 with hard, red winter wheat under a variety of irrigation conditions. Stepwise regression was used to compare correlation coefficients of several models including GDD alone or in combination with water variables (irrigation plus rainfall) regressed against number of days to heading. GDD summed by periods results in higher correlations with days to heading than when a single summative figure is used. The best fits were obtained when both GDD and water variables (summed for 2- or 4-wk periods prior to heading) were included in the regression. A base temperature of 4 C and a staring date of January 1 had the highest final correlation coefficient (R = 0.949) compared to 0 C base temperatures and earlier starting dates for GDD accumulations. The analysis indicates that autumn periods had little effect on the phenological development of wheat. The data suggest that water does play a part in phenology and might be incorporated into plant process models to arrive at a more rational understanding of how environmental variables affect crop development. (Author's abstract)
W88-03876

SOIL MOISTURE EXTRACTION MODEL,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W88-03954

PROBLEMS ARISING FROM THE FIELD CAPACITY CONCEPT IN COMPARING MEASURED SOIL MOISTURE DEFICITS WITH MORECS PREDICTIONS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W88-03955

PREDICTION OF SOIL MOISTURE DEFICIT: AN OPERATIONAL APPROACH,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W88-03957

ESTIMATION OF SOIL MOISTURE EXCESS, AND VERIFICATION,
Thames Water Authority, Reading (England). Thames Conservancy Div.
For primary bibliographic entry see Field 2D.
W88-03959

SIMULATING THE EFFECTS OF SOIL DEPTH AND CLIMATIC FACTORS ON CORN YIELD,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W88-04044

COMPARATIVE ABILITIES OF LEAF SURFACES TO NEUTRALIZE ACIDIC RAIN-DROPS. II. THE INFLUENCE OF LEAF WETTABILITY, LEAF AGE AND RAIN DURATION ON CHANGES IN DROPLET PH AND CHEMISTRY ON LEAF SURFACES,
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W88-04097

WATER RELATIONS AND OSMOTIC ADJUSTMENT OF LEAVES AND ROOTS OF LUPINS IN RESPONSE TO WATER DEFICITS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Lab. for Rural Research.
N. C. Turner, W. R. Stern, and P. Evans.
Crop Science CRPSAY, Vol. 27, No. 5, p 977-983, September-October 1987. 4 fig, 2 tab, 25 ref.

Descriptors: *Water deficit, *Lupins, *Plant tissues, *Plant water potential, *Osmotic pressure, Leaves, Roots, Drought, Plant physiology.

Increasingly, lupins (Lupinus spp.) are being grown as a dryland crop in marginal rainfall areas, yet their water relations characteristics and adaptation to water deficits are largely undescribed. The water relations and degree of osmotic adjustment in leaves and roots of lupins in a greenhouse and in the field were determined; four experiments were conducted. In the first two, the leaf water relations of Lupinus angustifolius and L. cosentinii were compared. The results showed the L. angustifolius leaves were more elastic and had a higher osmotic pressure under adequately watered conditions, but the degree of osmotic adjustment to a slowly imposed water deficit was negligible in L. angustifolius and about 0.2 MPa in L. cosentinii. In the third experiment, the water relations and osmotic adjustment of leaves and roots of five lupin species/cultivars were compared at a predawn leaf water potential of -1.6 MPa. Leaf elasticity in general was not influenced by water deficits. In the leaves, osmotic adjustment varied among species; L. pilosis and L. atlanticus had the greatest degree of osmotic adjustment (0.4-0.5 MPa) and L. angustifolius the least (0.1 MPa). The increases in osmotic pressure arising from a water deficit were paralleled by decreases in the turgid weight/dry weight ratio. In this greenhouse experiment, no osmotic adjustment was observed in the roots of any species. In the fourth experiment, conducted in the field, the leaves of L. angustifolius adjusted osmotically by 0.2 to 0.3 MPa and roots by about 0.4 MPa. The osmotic adjustment in both leaves and roots was accompanied by a decrease in the turgid weight/dry weight ratio. The data suggests that changes in turgid weight/dry weight ratio may provide a simple screening method for osmotic adjustment in Lupinus. (Author's abstract)
W88-04166

VEGETATION CHARACTERISTICS AND THE PREDICTION OF RUNOFF: ANALYSIS OF AN EXPERIMENT IN THE NEW FOREST, HAMPSHIRE,
Southampton Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W88-04239

2J. Erosion and Sedimentation

CHARACTERISTICS OF TURBULENCE OF THE BOTTOM REGION OF A FLOW,
For primary bibliographic entry see Field 8B.
W88-03621

EXPERIMENTAL INVESTIGATIONS OF THE DEFORMATION OF CHANNELS OF SAND CANALS,
T. Z. Zhuraev.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 595-598, April 1987. 4 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 32-34 ,October 1986.

Descriptors: *Channel morphology, *Channel erosion, *Scours, *Channel deformation, *Erosion,

*Sand canals, *Model studies, *Soviet Union, Sediment transport, Sediments, Hydraulics, Erosion, Kara-Kum Canal, Fluvial sediments, Flow rates, Flow velocity, Sediment profiles.

Numerous approximate methods of hydraulic modeling of the fluvial process as applied to various stretches of rivers and large unlined canals have been proposed. Laboratory data on a large-scale model composed of fine sand is presented. Using approximately the same soil conditions, a stretch of the Kara-Kum canal was used as the prototype. Natural sand with an average diameter of 0.20 mm was used as the erodible soil. Two series of experiments were conducted on the model with preservation of geometric similarity (first series) and various distortions of the vertical and horizontal scales. In both series, the Froude number was not fulfilled and in the model, the longitudinal slope was greater than in the prototype. For achieving greater similarity between model and prototype in a wave regime of sediment movement and kinematics of flow, it is necessary to fulfill geometric similarity. (Main-PTT)
W88-03625

MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN PAKISTAN,
Pakistan Forest Inst., Peshawar.
S. M. Khan.
Water Resources Journal, No. 149, p 40-43, June 1986. 6 ref.

Descriptors: *Sedimentation, *Sediment control, *Silting, *Pakistan, *Reservoirs, Reservoir operation, Reservoir releases, Reservoir silting.

Water is the mainstay of Pakistan's economy for irrigation, electricity generation and industrial production. The precious Mangla and Tarbela reservoirs are being silted up at the rate of 42,000 and 109,000 acre feet anually, due to faulty practices in the catchment areas. This is costing 2.3 billion rupees annually. The scientific management of these areas can reduce the siltation rate by 30 per cent. The Forest Department, the Water and Power Development Authority (WAPDA) and the Soil Conservation Organization are working in isolation to carry out proper land-usemanagement activities in the field, while research is being done by Pakistan Forest Institute and Pakistan Agricultural Research Council. The non-existance of a central co-ordinating organization, lack of trained personnel and research and monitoring facilities, non-involvment of the people and faulty implementation are major management problems. The monitoring of the effect of different activities on the sedimentation is being done only on a small-scale and on an experimental basis. Research and training in technological, economic and social aspects of watershed management have recently been started on a large-scale. (Author's abstract)
W88-03636

RESISTANCE TO FLOW IN GRAVEL-BED RIVERS,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-03642

DRAINED DEFORMATION AND FAILURE DUE TO CYCLIC PORE PRESSURES IN SOFT NATURAL CLAY AT LOW STRESSES,
Lakehead Univ., Thunder Bay (Ontario).
For primary bibliographic entry see Field 2G.
W88-03753

MODELING THE TRANSPORT OF FINE-GRAINED SEDIMENTS IN AQUATIC SYSTEMS,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
W. Lick.
Science of the Total Environment STENDL, Vol. 55, p 219-228, 1986. 18 ref.

Descriptors: *Sediment transport, *Suspended load, *Path of pollutants, *Model studies, *Sediment, Wave action, Currents.

A quantitative model of the entrainment and deposition of fine-grained sediments is based on the following properties of sediments: particle size, settling speeds, and the rates at which particles aggregate and disaggregate; entrainment and deposition; and hydrodynamics of wave action and currents. This model will be helpful in determining the effects of discharging waste products into lakes, rivers and oceans. (Ray-PTT)
W88-03860

EFFECTS OF LOW-LEVEL DAMS ON THE DISTRIBUTION OF SEDIMENT, TRACE METALS, AND ORGANIC SUBSTANCES ON THE LOWER SCHUYLKILL RIVER BASIN, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03896

SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA, JULY 8-16, 1982,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W88-03905

FLUID-DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W88-03926

TRACE-METAL AND ORGANOCHLORINE RESIDUES IN SEDIMENTS OF THE UPPER ROCKAWAY RIVER, NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W88-04151

MAIN CHANNEL LENGTH-AREA RELATIONSHIP FOR CHANNEL NETWORKS,
Universidad Nacional de Colombia, Medellin.
O. J. Mesa, and V. K. Gupta.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2119-2122, November 1987. 23 ref. Army Research Office Grant No. 21078-GS.

Descriptors: *Channels, *Channel morphology, *Channel flow, *Geomorphology, Mathematical analysis, Design standards, Channel length, Statistical analysis.

Motivated by the empirical relationship between the main channel length and the basin area for river networks, a similar equation was derived analytically using the random model postulates and the additional assumption that link lengths have a common exponential probability distribution. In networks with large magnitude m, the main channel length l(m), and the magnitude are related by l(m) is approximately equal to beta(2 pi) to the 1/2 power(2m) to the 1/2 power, where beta is mean link length. This result is utilized to explain another empirical relationship between the distance to the center of gravity l sub c(m) and the main channel length; l sub c(m) is approximately equal to l(m)/2. Observed deviations of the random model prediction regarding the main channel length from empirical observations is a problem particularly for large magnitude basins. The precise manner in which to modify the random model postulates to solve this problem has not been solved. (Lantz-PTT)
W88-04189

FLOCCULATION OF FINE-GRAINED LAKE SEDIMENTS DUE TO A UNIFORM SHEAR STRESS,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
C. H. Tsai, S. Iacobellis, and W. Lick.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 135-146, 1987. 10 fig, 2 tab, 27 ref.

Descriptors: *Flocculation, *Lake sediments, *Sediment transport, *Shear stress, Fluid shear, Suspended sediments, Particle size, Lake Erie, Detroit River.

Experiments were performed to investigate the effects of fluid shear on the flocculation of fine-grained lake sediments in fresh water. In these experiments, a Couette viscometer was used to apply a uniform shear stress to a sediment suspension. The sediments were from the Detroit River inlet of Lake Erie. They were prepared such that the initial (unflocculated) size distribution contained approximately 90% of its mass in particles less than 10 micrometers in diameter with the average diameter being about 3.5 micrometers. Experiments were performed at shear stresses of 1, 2, and 4 dynes/sq m and sediment concentrations of 50, 100, 400, and 800 mg/L, values which are characteristic of those found in the Great Lakes. Data in the form of floc size distribution as a function of time were obtained. For steady-state conditions, the median diameters of the flocs formed were typically 20 to 100 micrometer depending on shear stress and sediment concentration. Quantitative results for the decrease in the steady-state floc size with increasing shear stress and with increasing sediment concentration were obtained. The times required for flocculation to occur under different conditions were also determined and were typically on the order of 1 hr. (Author's abstract)
W88-04216

EROSION AND SEDIMENTATION ALONG A COHESIVE SHORELINE - THE NORTH-CENTRAL SHORE OF LAKE ERIE,
National Water Research Inst., Burlington (Ontario).
N. A. Rukavina, and A. J. Zeman.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 202-217, 1987. 8 fig, 10 tab, 48 ref.

Descriptors: *Erosion, *Sedimentation, *Shorelines, *Lake Erie, Sediment transport, Sedimentation rates, Sediment control.

A study of the distribution and texture of bluff and nearshore sediments of north-central Lake Erie was carried out to measure the patterns of erosion and sedimentation characteristic of a cohesive shoreline. Onshore deposits of the study area consist mainly of bluffs of cohesive glacial sediments standing at the waterline or separated from it by narrow intermittent beaches. The nearshore deposit is a narrow band of gravel to clay-sized postglacial sediment located between the shoreline and a broad offshore shelf of exposed glacial sediment. The width of the deposit increases from west to east and there is local widening and beach development at the three harbor areas of Ports Stanley, Bruce, and Burwell as the result of entrapment and diversion by harbor structures. A new sediment budget proposed for the reach shows an annual input of 6,000,000 tons of silt and clay and 2,000,000 tons of sand and gravel. Bluff erosion accounts for 89% of the sediment supply and nearshore-slope erosion and stream discharge for 10% and 1%, respectively. Although harbor structures have increased the volume of nearshore sediment retained by the reach, their effect on the sediment budget is minimal because of the high supply and transport rates. More than 99% of the sediment input is lost to the shoreline to the east and to the offshore basins by transport within the nearshore zone. The sediment remaining within the reach is coarser and better sorted than the source materials and appears to be stable in pattern and texture over the short term (1973-1979). (Author's abstract)
W88-04222

EVIDENCE FOR THE LAKE CHIPPEWA EXTREME LOW-WATER STAGE IN LAKE MICHIGAN,
Northeastern Illinois Univ., Chicago. Dept. of Earth Sciences.
R. Bader, and F. Pranschke.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 224-228, 1987. 3 fig, 14 ref.

Descriptors: *Palehydrology, *Paleolimnology, *Glacial lakes, *Lake Chippewa, *Water level, *Lake Michigan, History, Geology, Lake sediments, Fossils, Snails, Molluscs.

The established geological history of the Great Lakes region recognizes four prominent lake stages in postglacial Lake Michigan. During this time various lacustrine sediment layers (members) were deposited in the Lake Michigan basin creating the Lake Michigan Formation. Each member (Waukegan, Lake Forest, Winnetka, and Sheboygan) is correlated to a different water level stage. The lowest water level ever recorded in Lake Michigan, the Lake Chippewa Stage, occurred during the deposition of either the Lake Forest or Winnetka Members. The occurrence of this low-water stage has not been well documented because of insufficient evidence from deep water sediments. However, fossil invertebrate data were collected for shallow water clams and snails. The fossils are presently found in deep water sediments which identify the layer forming the lowest water stage, Lake Chippewa, in Lake Michigan. It appears that the Lake Chippewa low-water stage occurred during the deposition of the Winnetka Member. The Winnetka Member contained a high concentration of Pisidium clam shells and ostracod valves. In addition, this member contained characteristically shallow-water snails of the genera Gyraulus, Valvata, Amnicola, and Lymnaea. Previous paleomagnetic studies of the upper Winnetka Member indicate that this deposition and the Lake Chippewa low-water stage occurred between 6,370 and 9,700 years ago. (Author's abstract)
W88-04224

CHANNEL DEGRADATION IN THE MIDDLE ARVE RIVER, FRANCE,
Lyon-3 Univ. (France). Dept. of Geography.
J. L. Peiry.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 183-188, April-June, 1987. 3 fig, 1 tab, 17 ref.

Descriptors: *Channel degradation, *Arve River, *River beds, Sediment transport, Stream flow, Alpine regions, Rivers, Discharge, Bed load, France.

River bed degradation in response to changes in flow regime and sediment loads induced by human activity, has been widely recognized. Rivers have the capacity to transmit localized changes over a large area, particularly in the downstream direction, and large scale degradation can influence the whole fluvial system. River improvement work can be used to control extensive river bed entrenchment but, in the short and medium term at least, the restoration of pre-impact conditions is virtually impossible. With a dense population, Alpine intramontane alluvial plains are particularly sensitive to intervention. The channel bed degradation of the middle Arve river, France, the first tributary of the upper Rhone downstream of Lake Geneva is discussed. Water is supplied by the glaciated mountains of the Mont-Blanc massif. The high relief and the abundant and rapid run-off give rise to a high energy stream, with a natural bedload discharge estimated to be 150,000 cu m/yr in the vicinity of Geneva. The studied reach is 8 km long and situated between the downstream end of the Arve gap and the confluence of the Giffre river. A series of long profiles, surveyed between 1856 and 1981 is presented. (Lantz-PTT)
W88-04231

SCALE EFFECTS IN FLUVIAL SEDIMENT-ASSOCIATED CHEMICAL DATA,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
E. D. Ongley.
Hydrological Processes, HYPRE3, Vol. 1, No. 2, p 171-179, March 1987. 2 fig, 24 ref.

Descriptors: *Scale effects, *Ecological effects, *Suspended sediments, *Path of pollutants, Sediment transport, Metals, Phosphorus, Organic compounds, Water pollution sources.

Assessment of man's impact on fluvial systems frequently involves extrapolation in time and space from data collected as part of a water quality network. Extrapolation represents information transfer and is used for scenario building and risk assessment. Transfer functions for non-conservative quality variables are poorly understood. Metals, phosphorus, and organic contaminants, which are preferentially transported in association with suspended sediment, are especially susceptible to extrapolation errors. Information loss, which is inherent in extrapolation procedures, is characterized for sediment-associated substances by examining the assumptions and limitations of the sediment delivery ratio. A practical demonstration of scale effects and interpretive difficulties is provided using data from the Bow River, Alberta. Guidelines for data assessment and extrapolation are summarized for temporal effects and for three different spatial scales. (Author's abstract)
W88-04242

MATHEMATICAL MODEL FOR EVALUATION OF THE EFFECT OF SOIL EROSION ON SOIL PRODUCTIVITY,
Kentucky Univ., Lexington. Dept. of Statistics.
P. Todorovic, D. A. Woolhiser, and K. G. Renard.
Hydrological Processes, HYPRE3, Vol. 1, No. 2, p 181-198, March 1987. 7 fig, 14 ref.

Descriptors: *Mathematical models, *Soil erosion, *Soil productivity, Agriculture, Crop yield, Model studies, Stochastic process.

A stochastic model was developed to evaluate the long-term effect of soil erosion on soil productivity. Due to random variations in annual crop yield, the effect of erosion on crop production is not easily detectable in the short run, but becomes gradually evident over a sufficiently long time period. Under these circumstances, it seems that an experimental approach to this problem may be very difficult. The long period of time over which such an experiment has to be conducted may result in prohibitively high costs. In addition, it also means that eventual resolution of this problem must be postponed until a distant future time. The stochastic model formulated here provides a useful tool to assess the trend in quantitative changes in crop production due to erosion and to project future crop losses. The model shows the trend in crop production dynamics on a certain controlled crop-producing area affected by soil erosion if no changes in agricultural practices occur and no corrective measures are undertaken to neutralize soil erosion effects. The effects of soil erosion on crop production are quantified by the introduction of the concept of 'loss-rate functions,' which characterizes yield reductions resulting from soil erosion. Three cases are considered: 1) a constant loss rate, year after year; (2) a variable loss rate; and (3) a random-loss rate function. (Lantz-PTT)
W88-04243

EVALUATION OF THE UNIVERSAL SOIL LOSS EQUATION AND FIELD TECHNIQUES FOR ASSESSING SOIL EROSION ON A TROPICAL ALFISOL IN WESTERN NIGERIA,
Sokoine Univ. of Agriculture, Morogoro (Tanzania).
P. W. Mtakwa, R. Lal, and R. B. Sharma.
Hydrological Processes, HYPRE3, Vol. 1, No. 2, p 199-209, March 1987. 2 fig, 5 tab, 31 ref.

Descriptors: *Universal Soil Loss Equation, *Soil erosion, *Nigeria, *Alfisol, *Tropical regions, Mathematical studies, Erosion, Crop yield, Corn, Peas, Runoff, Comparison studies.

Four techniques for soil erosion assessment were compared over two consecutive seasons for bare-fallow plots and a maize-cowpea sequence in 1985 at IITA, Ibadan, Nigeria. The techniques used were: tracer (aluminum paint), nails (16 and 25), the rill method, and the Universal Soil Loss Equation (USLE). Soil loss estimated by these techniques was compared with that determined using the runoff plot technique. There was significantly more soil loss ($P < 0.01$) in bare-fallow than in plots under maize (Zea mays) or cowpea (Vigna unguiculata). In the first season, soil loss from plots sown to maize was 40.2 mg/ha compared with 153.3 mg/ha from bare-fallow plots. In the second season, bare-fallow plots lost 87.5 mg/ha against 39.4 mg/ha lost from plots growing cowpea. The techniques used for assessing erosion had no influence on the magnitude of soil erosion and did not interfere with the processes of erosion. There was no significant difference ($P < 0.05$) between soil erosion determined by the nails and the runoff plot technique. Soil loss determined on six plots (three under maize, three bare-fallow) by the rill technique, at the end of the season, was significantly lower ($P < 0.05$) than that determined by the runoff plot technique. The soil loss estimated by the rill method was 143.2, 108.8 and 121.9 mg/ha for 11, 11 and 8% slopes respectively, in compared to 201.5, 162.0, and 166.4 mg/ha measured by the runoff plot method. Soil loss measured on three bare-fallow plots on 10 different dates by the rill technique was also significantly lower ($P < 0.01$) than that measured by the runoff plot. In the first season the USLE significantly underestimated soil loss. On 11, 11, and 8% slopes, respectively, soil loss determined by the USLE was 77, 92, and 63% of that measured by the runoff plot. However, in the second season there was no significant difference between soil loss determined by the USLE and that determined by the conventional runoff plot technique. (Author's abstract)
W88-04244

ENTROPY AND PROBABILITY CONCEPTS IN HYDRAULICS,
Pittsburgh Univ., PA.
For primary bibliographic entry see Field 8B.
W88-04267

KINEMATIC PROPERTIES OF MUDFLOWS ON MT. ST. HELENS,
Montana State Univ., Bozeman. Dept. of Civil and Agricultural Engineering.
T. E. Lang, and J. D. Dent.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 646-660, May 1987. 9 fig, 1 tab, 19 ref.

Descriptors: *Mudflows, *Mount Saint Helens, *Kinematic waves, *Volcanoes, Viscosity, Snow, Surface runoff, Flow profiles.

Findings of a computer-based study of the mudflows on Mt. St. Helens following its eruption on May 18, 1980 are summarized. Analyses were made of the start-up dynamics and flow of mud down various drainages of the mountain, and of the surge wave generation in Swift Reservoir when the mudflow down East Pine Creek entered the reservoir. Viscosities of mudflows in the Muddy Creek and Pine Creek drainages were evaluated to establish a basis for general analysis of mudflow phenomena. Starting with estimates of snow deposition on the mountain, and incorporating the characteristics of the pyroclastic blast of the eruption, initiation of flow was approximated. Subsequent flow down different drainages was modeled, and time sequencing of the flows into Swift Reservoir was compared with measured reservoir elevations recorded on the morning following the eruption. Additional kinematics of the flows were compared with corresponding field measured data where possible. (Author's abstract)
W88-04271

UPLAND SOIL EROSION SIMULATION FOR AGRICULTURAL WATERSHEDS,
Auburn Univ., AL. Dept. of Agricultural Engineering.
K. H. Yoo, and M. Molnau.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 819-827, October 1987. 5 fig, 4 tab, 24 ref.

Descriptors: *Simulation analysis, *Soil erosion, *Agricultural effects, *Agricultural watersheds, *Model studies, Agricultural effects, Runoff, Sediment transport, Agricultural runoff, Temporal distribution, Spatial variation, Overland flow, Sediment-carrying capacity, Sediment transport, Rainfall, Snowmelt.

A soil erosion simulation model considers the physical conditions of agricultural watersheds and interfaces with the modified USDAHL-74 water-

shed hydrology model. The model simulates the detachment and transport of soil particles caused by raindrop impact and overland flow from rill and interrill areas. The model considers the temporal and spatial variations of plant residue, crop canopy cover, snow cover, and the moisture content of surface soil as modifying factors of the erosive forces of raindrop impact and overland flow. Overland flow and some of the physical parameters that are used in the erosion model are simulated in the time interval determined by the rainfall rate or snowmelt rate. The model compares the transport capacity of the overland flow and the sediment loaded in the overland flow to determine the fate account for the free soil particles that have already been detached and are readily available to be transported by the overland flow. The model was tested with data from two small agricultural watersheds in the Palouse region of the Pacific Northwest dryland. The model was calibrated by trial-and-error to determine the coefficients of the model. (Author's abstract)
W88-04282

ASSESSING FLUSHING-FLOW REQUIREMENTS FOR BROWN TROUT SPAWNING GRAVELS IN STEEP STREAMS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W88-04297

CROSS-CHANNEL MIXING AND ITS EFFECT ON SEDIMENTATION IN THE ORINOCO RIVER,
Princeton Univ., NJ. Dept. of Geological and Geophysical Sciences.
R. F. Stallard.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1977-1986, October 1987. 4 fig, 5 tab, 20 ref, append. NSF Grant EAR-8407651.

Descriptors: *Mixing, *Sediment transport, *Orinoco River, *Cross-channel flow, Sedimentation, Sediment distribution, Suspended sediments, Sediments, Sediment load, Suspended load, Deposition, Flow discharge, Channel flow, Ardes River.

At high discharge, cross-channel mixing of water in the Orinoco River main stem requires several days and up to 500 kilometers of downriver transit for completion. During mixing, substantial amounts of < 0.063 millimeters sediment are lost from suspension. The water closest to the left bank appears to lose the most, probably by deposition onto the floodplain. This occurs in two ways. First, sediment-laden left-bank tributaries draining the Andes, such as the Apure, deposit sediment in distributary systems following impoundment by the Orinoco backwater. Second, when sediment-laden waters from the Andes actually join the Orinoco, the slow nature of cross-channel mixing causes the water and sediment to be confined more to the left side of the channel. Significant sediment loss or storage probably occurs only near flood stage. Since sedimentation occurs preferentially on the left (Andean foreland basin) bank, the Orinoco remains stably situated on the border of the foreland basin with the Guayana shield. (Author's abstract)
W88-04319

MEASUREMENT OF COARSE BED-LOAD TRANSPORT BY MEANS OF THE MAGNETIC TRACER TECHNIQUE (MESSUNG DES GROBGESCHIEBETRANSPORTES MIT DER MAGNETTRACERTECHNIK),
Freie Univ. Berlin (Germany, F.R.). Inst. fuer Physische Geographie.
K. Bunte, S. G. Custer, P. Ergenzinger, and R. Spieker.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 60-67, July 1987. 13 fig, 14 ref.

Descriptors: *Bed Load, *Tracers, *Sediment transport, *Analytical methods, *River beds, Data acquisition, High flow, Data interpretation, Temporal distribution, Erosion, Sediments, Magnetic studies, Snowmelt, Floods, Gravel, Montana.

Under natural conditions the processes of coarse bed-load transport cannot be determined fully, nor do the various bed-load formulas provide satisfying results in calculating coarse bed-load transport. The use of samplers to measure coarse bed-load transport not only involves considerable sources for error, but also allows only a spatially and temporally limited insight into coarse bed-load transport. The measurement of spatial and temporal variation in transport is a basic requirement for the analysis of processes initiating and maintaining coarse bed-load transport. The magnetic tracer technique is based on the Faraday inductive principle. By making use of the natural magnetic content of pebbles and cobbles, the bed-load transport is measured and registered in high spatial and temporal resolution. The studies were conducted in a mountain river in Montana during a two-week snow melt runoff with distinct daily peaks, in the spring of 1986. A comparison of the hydrograph and the bed-load transport clearly reveals that the bed-load pulses are not a function of the hydraulic conditions alone. The daily temporal variations in bed-load transport can be interpreted only by combined analyses of the hydraulic conditions and the sources and sinks of the coarse bed-load material. (Airone-PTT)
W88-04348

RESULTS OF MAPPING A GROYNE-FIELD OF THE ELBE RIVER NEAR SCHNAKENBEK (ERGEBNISSE DER KARTIERUNG EINES BUHNENFELDES IN DER ELBE BEI SCHNAKENBEK),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
R. D. Wilken, and G. Posske.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 77-81, July 1987. 8 fig, 7 ref.

Descriptors: *Sediment load, *Groins, *Mapping, *Sediment transport, *Sediment distribution, Erosion, Rivers, Banks, Waterways, Navigable rivers, Dredging, Flow augmentation, Jetties, Flow control, Elbe River.

In a groin-field of the Elbe near Schnakenbek, at Elbe-km 575.3, measurements of sediment load and sediment distribution were conducted from September-October 1985. In some places within this zone a sediment thickness of more than 1.90 m was measured. (Discharge at the time was about 400 cu m/sec, with an average discharge of 751 cu m/sec). The total sediment load in the field was estimated at 5700 cu m, corresponding to 6000 tons (wet weight). If in other groin-fields of the Elbe upstream of the Geesthacht weir similar conditions prevail, influences from the deposited material on the suspended transport cannot be excluded. This effect might be ofimportance for the sediment process in Hamburg Harbor, when considering accumulations of contaminated, dredged materials. (Airone-PTT)
W88-04351

MAPPING AND RISK ASSESSMENT OF OXYGEN CONSUMPTION BY SEDIMENTS IN THE LOWER ELBE (KARTIERUNG UND RISIKOBETRACHTUNG DER SAUERSTOFFZEHRUNG VON SEDIMENTEN DER UNTER-ELBE),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W88-04352

NUMERICAL SIMULATION OF DEGRADATION OF ALLUVIAL CHANNEL BEDS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
I. Park, and S. C. Jain.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 7, p 845-859, July 1987. 8 fig, 3 tab, 23 ref, append. NSF Grant No. CEE80-23003.

Descriptors: *Mathematical analysis, *Simulation analysis, *Channel erosion, *Alluvial channels, Sediment transport, Bed load, Mathematical models.

The bed degradation in alluvial channels resulting from sediment interruption was simulated numerically by solving the one-dimensional momentum and continuity equations for water and sediment. A simple 'bed layer' model is proposed to simulate the plane bed armoring process; the model does not contain any parameter that needs calibration. The agreement between the numerical results and the available experimental data is satisfactory. (Author's abstract)
W88-04388

TRANSPORT OF BED SEDIMENT IN CLAY SUSPENSIONS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
H. Woo, P. Y. Julien, and E. V. Richardson.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 1061-1066, August 1987. 3 fig, 11 ref, append.

Descriptors: *Sediment transport, *Clays, *Suspensions, *Bed load, Mathematical studies, Sediment discharge, Graphical analysis.

The presence of fine sediments increases the bed sediment discharge. Concentrations of suspended sediments larger than 600,000 ppm (about 40% by volume) have been reported in the United States and in China. These hyperconcentrated flows have caused irrigation and flood control problems such as clogging and aggradation. Colby's method and Einstein's formulation of sediment discharge have been tested with the flume data previously obtained. The following conclusions were drawn from this analysis: (1) According to calculations based on Einstein's method, the sediment discharge in contact with the bed remains practically unchanged in presence of fine sediments; (2) the increase in total bed sediment discharge is mainly attributable to the increase in suspended sediment discharge; and (3) Colby's graphical relations yield results quite similar to those of Einstein without correction and do not provide better prediction of the total bed sediment discharge than Einstein's formula. (Lantz-PTT)
W88-04400

INFLUENCE OF CHANNEL WIDTH ON BED LOAD TRANSPORT CAPACITY,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson, and G. A. Griffiths.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 12, p 1489-1509, December 1987. 2 fig, 30 ref, 5 append.

Descriptors: *Channel width, *Bed load, *Sediment transport, Flow profiles, Flow rates, Mathematical analysis.

The influence of channel width on bedload capacity in river reaches of given slope, water discharge, and channel-bed material was examined. The view that transport capacity is a decreasing function of width is shown to be dependent upon an invalid premise. A contrary view - that transport capacity increases as channel width increases - was also considered. Conclusions based on the second view are inconsistent with transport formulas or are restricted to channels at a near-threshold state. The existence of an optimum width that maximizes capacity was demonstrated. This is a consequence of the nature of the relationship between bedload transport rates and flow intensity (notably a threshold condition) and of the relationship between flow resistance and depth. Expressions were derived for the optimum channel width and are shown to predict Gilbert's flume observations. Problems in applying this approach to natural channels include: (1) the uncertainly regarding the appropriate resistance law that should be used; (2) trying to establish which (if any) is the appropriate sediment transport relationship to use; and (3) the choice of the appropriate cross-sectional shape of the design channel. (Lantz-PTT)
W88-04407

LAMINAR EINSTEIN BED LOAD TRANSPORT EQUATION FOR OVERLAND SHEET FLOW,
Washington Univ., Seattle. Coll. of Forest Resources.
W. Zhang, and T. W. Cundy.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 12, p 1525-1538, December 1987. 8 fig, 2 tab, 30 ref.

Descriptors: *Overland flow, *Sediment transport, *Bed load, *Mathematical equations, *Laminar flow, Flow velocity, Mathematical analysis, Flow characteristics.

The Einstein bed load equation was modified for laminar overland flow by incorporating a laminar velocity profile and by estimating lift force as a component of a drag force. The model contains only one parameter, lambda, which must either be fitted or estimated a priori. The results of a sensitivity analysis for lambda indicate the following: predicted sediment transport varies directly with lambda; lambda is nearly constant for rainfall intensities 5 > cm/hr; and for rainfall intensities less than 5 cm/hr, lambda varies considerably. An optimized value of 50 was determined. The simulated results by the laminar Einstein bed load equation with lambda = 50 agree quite well with previously obtained data. (Lantz-PTT)
W88-04409

CRITIQUE OF THE REGIME THEORY FOR ALLUVIAL CHANNELS,
For primary bibliographic entry see Field 2E.
W88-04455

SEDIMENT CONVECTION-DIFFUSION AND BEDFORM LENGTH,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
M. I. Haque, and K. Mahmood.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1381-1401, November 1987. 13 fig, 1 tab, 15 ref, 2 append. NSF Grant Nos. INT-8009474 and CEE-8313603.

Descriptors: *Channel morphology, *Bed loads, *Sediment transport, *Suspended sediment, *Convection, *Diffusion, *Bedform length, *Hydraulic properties, Flow patterns, Hydrodynamics, Mathematical analysis, Flow profiles, Finite element method.

In connection with the mechanics of ripples and dunes, the governing equations of convection-diffusion of suspended sediment in two-dimensional flow fields over ripples or dunes are solved by the finite-element method. The role of suspended sediment in determining the steady bedform length is theoretically investigated. The postulate that, in the case of steady bedforms, the diffusive flux vector at any point on the stoss must point into the interior of the flow region divides mathematically acceptable solutions into two categories: (1) Physically acceptable solutions; and (2) physically unacceptable solutions. The marginal solutions, which lie on the common boundary between the two classes in the solution space, are of special interest. They represent steady bedforms with minimum length under the prevailing flow conditions, and they are conjectured to correspond to the steady bedforms occurring in nature. Finally, the theory is compared with the physical observations made in flumes, canals, and rivers. The comparison shows a fair agreement. (Author's abstract)
W88-04456

MEASURES OF FLOW INTENSITY AS PREDICTORS OF BED LOAD,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1402-1421, November 1987. 10 fig, 1 tab, 18 ref, append.

Descriptors: *Flow intensity, *Bed load, *Sediment load, *Mathematical studies, *Sediment transport, Stress, Hydrodynamics, Flow velocity.

The relative merits of different measures of flow intensity as predictors of bed-load transport rates are assessed. Tractive stress, when based on depth and slope, is a poor predictor, especially in narrow channels. Correct application requires elimination of wall and bedform roughness, leaving only that stress acting on the bed grains. When this is done, excellent correspondence with bed-load rates is found. Vertically averaged velocity requires a correction for depth and particle size; then it is directly comparable with grain tractive stress. Stream power has limitations as a predictor because it is the product of vertically averaged velocity and bed tractive stress, and hence subject to the problems that those variables individually experience. Unit stream power is a good predictor of concentration in some circumstances. (Author's abstract)
W88-04457

SEDIMENT ENTRAINMENT AND DEPOSITION MEASUREMENTS IN LONG ISLAND SOUND,
Ohio State Univ., Columbus.
K. W. Bedford, O. Wai, C. M. Libicki, and R. Van Evra.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1325-1342, October 1987. 11 fig, 1 tab, 22 ref. Office of Naval Research Contract No. N00014-83-k-003, NOAA Ohio Sea Grant Contract No. NA91AA-D-00095, and EPA Contract No. CR-811731-01-0.

Descriptors: *Sediment transport, *Sedimentation, *Entrainment, *Long Island Sound, Hydrodynamics, Sediment transport, Flow velocity, Turbulence, Mathematical analysis, Tidal hydraulics.

Entrainment and deposition fluxes were measured in Central Long Island Sound. Data were collected with a 3-MHz acoustic transceiver range gated to sample the sediment concentration in 1-cm intervals in the bottom 70 cm of the water column. Horizontal and vertical velocities were sampled 68 cm above the bottom. A turbulent control volume derivation was used to estimate the fluxes and their variation over one 3.5-hr deployment and a second deployment that spanned a tidal cycle. Time histories of three measures of the shear stress as well as the turbulent and wave kinetic energy were correlated with the entrainment fluxes. Turbulent and wave kinetic energy was the most reliable correlate with entrainment while the Reynolds' stress and drag coefficient estimates fared less well, the former failing at ebb tide, and the latter during periods of low average velocity. (Author's abstract)
W88-04467

2K. Chemical Processes

DISSOLVED OXYGEN: METHOD COMPARISON WITH POTENTIOMETRIC STRIPPING ANALYSIS,
Jordan Univ., Amman. Analytical Chemistry Labs.
For primary bibliographic entry see Field 2B.
W88-03637

KINETICS OF THE REACTION BETWEEN NITROGEN DIOXIDE AND WATER VAPOUR,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Inorganic Chemistry.
R. Svensson, E. Ljungstrom, and O. Lindqvist.
Atmospheric Environment ATENBP, Vol. 21, No. 7, p 1529-1539, July 1987. 10 fig, 1 tab, 18 ref.

Descriptors: *Air pollution sources, *Water pollution sources, *Acid rain, *Chemical reactions, *Water chemistry, *Nitrogen dioxide, *Water vapor, *Nitrous acid, *Kinetics, Mathematical equations, Surface area, Temperature.

The rate of disappearance of nitrogen dioxide (NO2) with water vapor and formation of nitrous acid (HONO) in the dark has been investigated in batch experiments. IR spectroscopy was used to determine the concentrations of NO2, HONO and NO. The reaction is first order both with respect to NO2 and water vapor proceeds heterogenously on most unpoisoned surfaces. Initially, the amount of HONO formed is close to half the NO2 which has disappeared. When the surface in the present reactor (surface to volume ratio = 14/m) has reached its limiting state of poisoning, the reaction is still active and the NO2 disappearance follows a mathematical expression. The S/V ratio dependence of the rate shows that a heterogeneous reaction proceeds but the existing evidence is not conclusive about a possible homogeneous contribution to the remaining activity. A rate expression which describes the overall reaction at temperatures around 25 C, when the surface present is made passive. (Alexander-PTT)
W88-03778

WINTER STUDY OF AIR, CLOUD AND PRECIPITATION CHEMISTRY IN ONTARIO, CANADA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W88-03779

INFLUENCE OF TEMPERATURE ON OXYGEN TRANSFER,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
A. C. Chao, D. S. Chang, C. Smallwood, and W. S. Galler.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 722-735, August 1987. 7 fig, 28 ref.

Descriptors: *Temperature effects, *Water chemistry, *Oxygen transfer, *Equations, *Reaeration rate, Water temperature, Solutions, Oxygen, Surface area.

An additional interpretation of the equation proposed by O'Connor is presented for calculating the reaeration rate constant of natural water bodies. In O'Connor development of the reaeration rate constant, K sub 2, the hyperbolic tangent value in the equation was assumed to be 1 and neglected. Using the simplified form, the calculated reaeration rate constant increases at higher water temperature. Evidence is presented to show that this hyperbolic tangent term may not always be 1. Hence, it cannot be omitted from the original equation developed for calculating the reaeration coefficient. The calculated reaeration rate constant decreases versus increasing water temperature at low surface renewal rates while it increases at higher surface renewal rate levels. Thus, although the reaeration coefficient increases at higher water temperature for aeration facilities used in wastewater treatment plants, it may decrease with increasing water temperature for natural water bodies where the surface renewal rate is low. (Author's abstract)
W88-03793

KINETICS OF ADSORPTION ON ACTIVATED CARBON: I. SINGLE-SOLUTE SYSTEMS,
Norges Tekniske Hoegskole, Trondheim.
For primary bibliographic entry see Field 5F.
W88-03795

KINETICS OF ADSORPTION ON ACTIVATED CARBON: II. MULTISOLUTE SYSTEMS,
Norges Tekniske Hoegskole, Trondheim.
For primary bibliographic entry see Field 5F.
W88-03796

KINETICS OF ADSORPTION ON ACTIVATED CARBON: III. NATURAL ORGANIC MATERIAL,
Norges Tekniske Hoegskole, Trondheim.
For primary bibliographic entry see Field 5F.
W88-03797

IMPROVED SPARGER FOR PURGE AND TRAP CONCENTRATOR USED FOR THE ANALYSIS OF VOLATILE ORGANICS IN LANDFILL LEACHATES AND SEPTIC SAMPLES,
Connecticut Univ., Storrs. Dept. of Chemistry.

For primary bibliographic entry see Field 5A.
W88-03834

ISOLATION OF NONVOLATILE ORGANIC SOLUTES FROM NATURAL WATERS BY ZEOTROPHIC DISTILLATION OF WATER FROM N,N-DIMETHYLFORMAMIDE,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W88-03835

SIMULTANEOUS DETERMINATION OF GALLIUM AND ZINC IN BIOLOGICAL SAMPLES, WINE, DRINKING WATER, AND WASTEWATER BY DERIVATIVE SYNCHRONOUS FLUORESCENCE SPECTROMETRY,
Malaga Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W88-03882

RECOVERY STUDIES OF VOLATILE ORGANICS IN SEDIMENTS USING PURGE/TRAP METHODS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W88-03883

RATE OF FERROUS IRON OXIDATION IN A STREAM RECEIVING ACID MINE EFFLUENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03893

RELATION BETWEEN GROUNDWATER QUALITY AND MINERALOGY IN THE COAL-PRODUCING NORTON FORMATION OF BUCHANAN COUNTY, VIRGINIA,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03895

PRIMER ON TRACE METAL-SEDIMENT CHEMISTRY,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03899

CARBONATE CHEMISTRY OF AQUATIC SYSTEMS; VOLUME 2: HIGH SALINITY WATERS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 1B.
W88-03949

NATURAL ENRICHMENT OF ARSENIC IN LOCH LOMOND SEDIMENTS,
Glasgow Univ. (Scotland). Dept. of Forensic Medicine and Science.
J. G. Farmer, and M. A. Lovell.
Geochimica et Cosmochimica Acta GCACAK, Vol. 50, No. 9, p 2059-2067, September 1986. 10 fig, 51 ref.

Descriptors: *Arsenic, *Water chemistry, *Diagenesis, *Bottom sediments, *Loch Lomond, *Scotland, *Lake sediments, Path of pollutants, Adsorption.

Concentrations of arsenic in surface or near-surface sediment in 12 of 13 cores from the three major basins of Loch Lomond are substantially enhanced, up to 675 mg/kg compared with background values of 15-50 mg/kg. Sedimentary As profiles are attributed to post-depositional enrichment processes since there are no recent significant sources of environmental As contamination, anthropogenic or natural, in the Loch Lomond area. The enrichments can be interpreted in terms of post-depositional diagenetic remobilization processes in sediment reducing zones, followed by upward migration of As through interstitial waters and oxidation/adsorption/precipitation reactions in near-surface oxidizing layers. Confirmation of the diagenetic/adsorption hypothesis is provided directly by the analysis of As species (1.5-81 micrograms/L) in pore water and indirectly via comparison with sedimentary phosphorus. (Author's abstract)
W88-03993

CHEMICAL PROCESSES GOVERNING SOIL AND WATER ACIDIFICATION,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-04014

OBSERVATIONS OF THE PREFERENTIAL LOSS OF MAJOR IONS FROM MELTING SNOW AND LABORATORY ICE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
P. Brimblecombe, S. L. Clegg, T. D. Davies, D. Shooter, and M. Tranter.
Water Research WATRAG, Vol. 21, No. 10, p 1279-1286, October 1987. 6 fig, 26 ref.

Descriptors: *Snowmelt, *Ice, *Chemical reactions, *Water pollution sources, Sulfates, Nitrates, Chlorine, Magnesium, Potassium, Sodium, Solute transport, Fractionation, Chemical analysis, Brines.

Two types of laboratory experiments were undertaken to understand changes in the ionic composition of solutions from melting snows: (1) a set of field-laboratory experiments which involved partially melting recently collected snows and (2) experiments on the controlled melting of artificial ices of known composition. Sulfate and nitrate ions are preferentially lost with respect to chloride during the melting process so apparent elution sequence maybe written SO4(2-) > NO3(-) > Cl(-). Of the cations, sodium appears to be removed least readily giving an elution sequence Mg(2+) = K(+) > Na(+). In the laboratory, the differences in the efficiency of removal of ions from ice are small in the first stages of melting, but pronounced by the end of the melt. Sodium and chloride are expected to be proportionally enriched in residual leached snow packs. This is generally born out by field observations. The preferential loss of some ions is more evident in aged laboratory ice than in the freshly made ice. The changes in the ice and meltwater composition throughout the process of melting may be understood to arise from the mixing of two types of solutions: (i) an intergranular surficial brine with high solute concentration that occupies the ice grain boundaries and (ii) the meltwater from the ice grains. (Author's abstract)
W88-04032

QUANTITATIVE DETERMINATION OF VOLATILE CARBOXYLIC ACIDS IN FORMATION WATERS BY ISOTACHOPHORESIS,
Bergen Univ. (Norway). Dept. of Chemistry.
T. Barth.
Analytical Chemistry ANCHAM, Vol. 59, No. 18, p 2232-2237, September 15, 1987. 4 fig, 5 tab, 15 ref.

Descriptors: *Water chemistry, *Geochemistry, *Diagenesis, *Volatile acids, *Carboxylic acids, *Formation waters, *Isotachophoresis, Chemical analysis, Quantitative analysis, Oil fields.

The composition and concentration of the highly water soluble volatile organic acids found in waters associated with oil-bearing formations are interesting in several geochemical contexts. Capillary isotachophoresis has been found to be suitable for the quantitative determination of these compounds in formation water samples. The separation capacity for a comprehensive set of mono- and polyfunctional standards has been investigated. Calibration curves are straight lines with correlation coefficients > 0.99. Concentration levels of 0.02 to 20 mM of each compound can be determined. No sample preparation is required. The procedure is applied to the analysis of formation waters from the Norwegian continental shelf, showing levels of acetic acid up to 16 mM. (Author's abstract)
W88-04036

DETERMINATION OF FE(III) AND FE(II) IN OXALATE EXTRACTS OF SEDIMENT,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W88-04042

COMPARATIVE ABILITIES OF LEAF SURFACES TO NEUTRALIZE ACIDIC RAINDROPS. II. THE INFLUENCE OF LEAF WETTABILITY, LEAF AGE AND RAIN DURATION ON CHANGES IN DROPLET PH AND CHEMISTRY ON LEAF SURFACES,
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W88-04097

RATE CONSTANTS FOR SOME OXIDATIONS OF S(IV) BY RADICALS IN AQUEOUS SOLUTIONS,
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
R. E. Huie, and P. Neta.
Atmospheric Environment ATENBP, Vol. 21, No. 8, p 1743-1747, August 1987. 2 fig, 2 tab, 19 ref. USEPA Agreement DW13931327-01-0.

Descriptors: *Oxidation, *Rate constants, *Sulfur compounds, *Fate of pollutants, *Acid rain, *Chemical reaction, Fluid drops, Atmospheric droplets, Air pollution, Autoxidation, Pollutants, Radicals, Sulfites.

Rate constants were measured for several radical reactions important in the autoxidation of S(IV) in atmospheric droplets. For the reactions of the hydroxy radical with sulfite and bisulfite, the rate constants were 5.2 times 10 to the 9th power and 4.5 times 10 to the 9th power/mol/sec (M/s), respectively. For the reaction of the dichloride radical anion with bisulfite, a rate constant of 3.4 times 10 to the 8th power/M/s was obtained. The peroxysulfate radical reacted with sulfite with a rate constant of 1.3 times 10 to the 7th power/M/s, but only an upper limit of 300,000 could be derived for its reaction with bisulfite. In some cases, the rate constants are significantly different from those used previously in atmospheric models. The use of these results in a simple model suggests that secondary radical-radical reactions may be of considerable importance in the mechanism of sulfite autoxidation in the atmosphere. (Author's abstract)
W88-04136

MEASUREMENT OF THE ENTRAPMENT OF SULFUR DIOXIDE BY RIME ICE,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W88-04137

DETERMINATION OF CARBON DISULFIDE IN NATURAL WATERS BY ADSORBENT PRECONCENTRATION AND GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
K.-H. Kim, and M. O. Andreae.
Analytical Chemistry ANCHAM, Vol. 59, No. 22, p 2670-2673, November 15, 1987.

Descriptors: *Carbon disulfide, *Analytical methods, *Gas chromatography, *Flame photometry, Natural waters, Chromatography, Photometry, Detection limits, Water chemistry.

A new procedure to determine carbon disulfide (CS2) in an aqueous matrix at environmental levels combines gas chromatography/flame photometric detection (GC/FPD) with the Carbosieve preconcentration method. The volatile CS2 is stripped out of up to 1.8 liter of sample by a nitrogen gas stream

and preconcentrated on a Carbosieve adsorption tube. This tube is then attached to the GC/FPD system and heated to desorb CS2 which is collected in a liquid nitrogen cooled trap, separated on a Chromosil 330 column, and detected by a flame photometric detector. The CS2 peak is recorded and integrated electronically. The detection limit is about 1 picomol/liter CS2. The analytical precision is 9%. The method has been used on both seawater and other natural water samples (e.g., St. Marks Estuary, Florida and Lake Bradford, Florida). CS2 was ubiquitous in the natural waters tested. The average concentration of CS2 in six samples of the estuarine water was 103.0 picomol/liter and in the seven samples of the lake water was 43.0 picomol/liter. (Lantz-PTT)
W88-04170

BASIN SCALE MODEL OF SOLUTE TRANSPORT,
Padua Univ. (Italy). Ist. di Idraulica.
A. Rinaldo, and A. Marani.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2107-2118, November 1987. 7 fig, 41 ref.

Descriptors: *Solute transport, *Basins, *Model studies, Mathematical models, Rainfall, Sorption, Chemical reactions, Statistical analysis, Kinetics, Nitrates.

A mathematical model based on conditional probability distributions is proposed for solute yield response to rainfall impulses at the basin scale. Solutes enter the mass balance because of sorption processes between fixed phases and the carrier flow. This approach allows to be addresses the individual role and the mutual connection of the hydrologic response and of macroscopic sorption kinetics controlling basin scale release processes. Mass response functions (MRFs) from geomorphology and statistical mechanics are derived and used to analyze experimental records. A synthesis of nonlinear effects in the mechanism of chemical supply to the carrier and the derivation of concentration distributions was also attempted. Three-parameter generalized gamma distributions provide sound physical and statistical insight and are studied to the interpretation of field data. A dimensionless number is defined as the ratio of 2 times the characteristics of the sorption kinetics and of the residence in the basin. The number is related to total solute loads in the runoff. The mathematical construct leading to the MRF accounts for the observed variability of the instantaneous and time-averaged concentration/discharge relations. As an example, discharge characteristics of NO3-N are analyzed via suitable MRFs. The results compare favorably with extensive evidence collected in a small Japanese catchment and capture the dominant modes of the process behavior. (Author's abstract)
W88-04188

LABORATORY INVESTIGATION OF LONGITUDINAL DISPERSION IN ANISOTROPIC POROUS MEDIA,
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. E. Silliman, L. F. Konikow, and C. I. Voss.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2145-2151, November 1987. 11 fig, 1 tab, 19 ref.

Descriptors: *Laboratory analysis, *Solute transport, *Path of pollutants, *Porous media, *Anisotropy, Permeability coefficient, Sodium chloride.

Mechanisms that may cause anisotropy in the dispersion coefficient and the relation between anisotropy in hydraulic conductivity and anisotropy in longitudinal dispersion were investigated in the laboratory. Measurements of sodium chloride concentration (used as a tracer) were made at 105 in situ sampling locations in a new type of sand box designed to allow flow in either of two perpendicular directions. Two types of hydraulic anisotropy were examined. The first consisted of structural zones of increased hydraulic conductivity within a lower conductivity medium. The second type involved low conductivity platelike inclusions within a homogeneous, isotropic medium. The plates were aligned such that the tortuosity was increased only in one principal direction of permeability. Results using two examples of the first type of media showed that the apparent longitudinal dispersivities for flow parallel to the high conductivity direction were greater than those perpendicular to this direction. Two examples of the second type of media produced smaller apparent longitudinal dispersivities for flow parallel to the high conductivity direction. The results suggest that the mechanisms causing dispersive anisotropy can be related, conceptually, to the factors causing hydraulic anisotropy. (Author's abstract)
W88-04192

WATER TREATMENT RELATED CHARACTERIZATION OF THE PHOTOCHEMICAL DEGRADATION PRODUCTS OF AQUATIC HUMIC SUBSTANCES (AUFBEREITUNGSORIENTIERTE ASPEKTE DES PHOTOCHEMISCHEN ABBAUS AQUATISCHER HUMINSTOFFE),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 5F.
W88-04341

COMPARATIVE ANALYSIS OF IRON, MANGANESE, SILICA, PHOSPHORUS, AND SULFUR IN THE HYPOLIMNIA OF CALCAREOUS LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W88-04440

2L. Estuaries

EFFECTS OF MECHANICAL AND MANUAL HARVESTING OF LUGWORMS ARENICOLA MARINA L. ON THE BENTHIC FAUNA OF TIDAL FLATS IN THE DUTCH WADDEN SEA,
Rijksinstituut voor Natuurbeheer, Texel (Netherlands).
T. van den Heiligenberg.
Biological Conservation BICOBK, Vol. 39, No. 3, p 165-177, March 1987. 5 fig, 13 ref.

Descriptors: *Lugworms, *Wadden Sea, *Benthic fauna, *Aquatic populations, *Exploitation, *Resources management, *Tidal flats, *Ecosystems, Water birds, Mechanical equipment, Baits, Polychaetes, Shellfish, Biological samples, Biomass.

Effects of bait digging by hand and mechanical harvester of Arenicola marina (L.) on the macrobenthic fauna of the Dutch Wadden Sea were investigated. Samples were taken on two tidal flat areas: the Balgzand and the Vlakte van Kerken from March to October 1981. Most of the major species were severely reduced immediately after digging. Some species (Macoma baltica and Scoloplos armiger) showed a fast return into the depopulated area. Further recovery varied per species. In general there was a larger recruitment of juveniles in the dug-over areas compared to the non-disturbed areas. Mechanical harvesting was more efficient--caught more Arenicola per square meter--than hand harvesting. Hand diggers caused less mortality of other benthic animals per gram Arenicola harvested than mechanical harvesters. Disturbance of feeding birds is discussed. People walking and hand diggers caused a serious problem. (Authors's abstract)
W88-03591

HYDROCARBON LEVELS IN THE SWARTKOPS ESTUARY: A PRELIMINARY STUDY,
Port Elizabeth Univ. (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W88-03774

EMISSIONS OF BIOGENIC SULPHUR COMPOUNDS FROM SEVERAL WETLAND SOILS IN FLORIDA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
W. J. Cooper, D. J. Cooper, E. S. Saltzman, W. Z. de Mello, and D. L. Savoie.
Atmospheric Environment ATENBP, Vol. 21, No. 7, p 1491-1495, July 1987. 4 fig, 1 tab, 10 ref. NSF grant ATM 84-05921.

Descriptors: *Biogenic emissions, *Sulfur compounds, *Wetlands, *Florida, Sulfides, Plants, Diel variation, Emissions, Peat.

Emission rates of the biogenic sulfur gases hydrogen sulfide, dimethyl sulfide, carbon disulfide and dimethyl disulfide have been measured from the exposed soils of five wetland plant communities in Florida. Dimethyl sulfide and hydrogen sulfide were the predominant species emitted. All the studied ecosystems showed diel variation in the emission rates of the biogenic sulfur gases with the highest emissions rates occurring early- to mid-afternoon, and the lowest emission rates occurring during the early morning. The relative magnitude of emissions from the individual ecosystems followed the trend Distichlis spicata > Avicennia germinans > Batis maritima = Juncus roemerianus = Cladium jamaicense. Only the emission rates from the peaty D. spicata site are comparable in magnitude to previous emission measurements in wetland ecosystems of Spartina alterniflora and associated mud flats. (Author's abstract)
W88-03776

MODELING VOLATILE ORGANICS IN THE DELAWARE ESTUARY,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W88-03792

HIGH RATES OF CONSUMPTION OF BACTERIA BY PELAGIC CILIATES,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.
W88-03822

RAPID AMMONIUM UPTAKE AND NITROGEN INTERACTIONS IN FIVE INTERTIDAL SEAWEEDS GROWN UNDER FIELD CONDITIONS,
British Columbia Univ., Vancouver. Dept. of Botany.
T. E. Thomas, and P. J. Harrison.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 107, No. 1, p 1-8, April 13, 1987. 1 fig, 1 tab, 29 ref.

Descriptors: *Ammonium, *Nitrate, *Intertidal areas, *Algae, *Intertidal macrophytes, Nutrients, Aquatic vegetation.

Time courses of ammonium and nitrate uptake rates were determined for five intertidal macrophytes, two perennials and three annuals, collected directly from the field. When a 15 micromolar pulse of ammonium was added to the incubation medium all three annuals and one of the two perennials showed enhanced ammonium uptake rates for the first 15 minute of a 30-min exposure. This is the first report known to the authors of non-linear nutrient depletion by plants grown in the field. There was no enhancement in the initial nitrate uptake rate. The nitrate uptake rate had to be induced in the low intertidal annual by incubating it in 30 micromolar nitrate for 20 minutes. All species took up both ammonium and nitrate simultaneously. Two annuals exhibited a 50% decrease in nitrate uptake in the presence of ammonium. Ammonium concentrations of more than 5 micro molar were necessary to inhibit nitrate uptake in the former plants. (Author's abstract)
W88-03837

EFFECTS OF LAND USE HISTORY ON SEDIMENTATION IN THE POTOMAC ESTUARY, MARYLAND,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W88-03901

SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA, JULY 8-16, 1982,
Geological Survey, Doraville, GA. Water Resources Div.
D. B. Radtke.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Professional Paper 1347, 1985. 120 p, 27 fig, 17 tab, 23 ref.

Descriptors: *Suspended sediment, *Sediment transport, *Estuaries, *Georgia, *Florida, Velocity, Salinity, Temperature, Camden County, Nassau County, Kings Bay, Cumberland Sound.

Water quality, bottom-material, suspended-sediment, and current velocity data were collected during July 1982 in Kings Bay and vicinity to provide information on the source and transport of estuarine sediments. Kings Bay and Cumberland Sound, the site of the Poseidon Submarine Base in southeast Georgia, are experiencing high rates of sediment deposition and accumulation, which are causing serious navigational and operational problems. Velocity, bathymetry, turbidity, and bottom-material data suggest sediment transported from lower Kings Bay is accumulating deposits of suspended sediment transported from Cumberland Sound on the floodtide and from upper Kings Bay and the tidal march drained by Marianna Creek on the ebbtide. Suspended-sediment discharges computed for consecutive 13-hr ebbtides and floodtides showed that a net quantity of suspended sediment was transported seaward from upper Kings Bay and Marianna Creek. A net landward transport of suspended sediment computed at the St. Marys Entrance indicated areas seaward of St. Marys Entrance may be supplying sediment to the shoaling areas of the estuary, including lower Kings Bay. (USGS)
W88-03905

MULTIVARIATE APPROACH TO THE INVESTIGATION OF NUTRIENT INTERACTIONS IN THE BARATARIA BASIN, LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W88-03936

VARIABILITY IN THE CHEMISTRY OF ESTUARINE PLANTS AND ITS EFFECT ON FEEDING BY CANADA GEESE,
Marine Biological Lab., Woods Hole, MA.
For primary bibliographic entry see Field 2H.
W88-04012

APPLICATION OF PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY TO THE CHARACTERIZATION OF HUMIC SUBSTANCES RESULTING FROM DECAY OF AQUATIC PLANTS IN SEDIMENTS AND WATERS,
Perpignan Univ. (France). Lab. of Marine Sedimentalogy and Geochemistry.
For primary bibliographic entry see Field 2H.
W88-04022

GAS EXCHANGE CHARACTERISTICS OF GULF OF MEXICO COASTAL MARSH MACROPHYTES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
S. R. Pezeshki, R. D. DeLaune, and W. H. Patrick.
Journal of Experimental and Marine Biology JEMBAM, Vol. 111, p 243-253, September 22, 1987. 5 fig, 1 tab, 21 ref.

Descriptors: *Marshes, *Gulf of Mexico, *Gas exchange, *Ecosystems, *Macrophytes, Spartina, Panicum, Photosynthesis, Temperature, Louisiana.

Gas exchange characteristics of three major Louisiana Mississippi River deltaic plain marsh species, Spartina patens (Ait.) Muhl., Spartina alterniflora Lois., and Panicum hemitomon Shult., were studied under controlled environment conditions. The optimum temperature for maximum photosynthesis was approximately 36 C for S. patens, 27 C for S. alterniflora, and 28 C for P. hemitomon. Net photosynthesis rates at optimum temperature averaged 20.1 micromol/sq m/sec in S. patens, 22.8 micromol/sq m/sec in S. alterniflora, and 11.4 micromol/sq m/sec in P. hemitomon. Photosynthetic light saturation occurred at approximately 720, 530, and 750 micromol/sq m/sec in S. patens, S. alterniflora, and P. hemitomon, respectively. Only S. patens had a midday depression of stomatal conductance, but net photosynthesis was not reduced by the depression. Maximum stomatal conductances were 285 mmol/sq m/sec in S. patens, 238 mmol/sq m/sec in S. alterniflora, and 335 mmol/sq m/sec in P. hemitomon. In contrast, net photosynthesis values were lower in P. hemitomon compared with the Spartina species, indicating a greater degree of water use efficiency of photosynthesis for both Spartina species. (Author's abstract)
W88-04035

APPLICATION OF LANDSAT THEMATIC MAPPER TO INLET DYNAMICS, OLD DRUM INLET, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
For primary bibliographic entry see Field 7B.
W88-04056

SEASONAL AND SPATIAL DISTRIBUTION OF EXTRACELLULAR ENZYMATIC ACTIVITIES AND MICROBIAL INCORPORATION OF DISSOLVED ORGANIC SUBSTRATES IN MARINE SEDIMENTS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
L. A. Meyer-Reil.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 8, p 1748-1755, August 1987. 9 fig, 31 ref. German Research Council Grants Me 509/3-1 and Me 509/3-2.

Descriptors: *Marine sediments, *Baltic Sea, *Enzymes, *Organic matter, *Phytoplankton, Biomass, Microorganisms, Sedimentation, Seasonal variation, Spatial distribution, Absorption, Microbial degradation, Microbiological studies, Radioactive tracers, Brackish water, Bartic Sea, Kiel Bight.

Seasonal and spatial distributions of extracellular enzymatic activities and microbial incorporations of dissovled organic substrates were followed in sediments of the brackish water Kiel Bight (Baltic Sea, Federal Republic of Germany). Enzymatic hydrolysis of polymeric organic compounds was determined by means of fluorogenic substrates (4-methylumbelliferyl-beta-D- glucoside L-leucine-4-methylcoumarinyl-7-amide hydrochloride); incorporation of dissolved organic substrates into microbial biomass was measured by using tritiated substances (acetate, leucine, and thymidine). Based on a recently developed core injection technique, substrates were injected in microliter portions into undistrubed sediment cores. Enzymatic and incorporation activities underwent strong seasonal variations related to the enrichment of organic material in the sediment surface following sedimentation events. The input of the phytoplankton bloom during autumn caused stimulation of both enzymatic hydrolysis of polymeric organic compounds and microbial incorporation of dissolved organic substrates. Following input by spring phytoplankton bloom, mainly incorporation activities were stimulated. In late spring the development of the benthic fauna obviously greatly influenced microbial activities. During summer individual periods of high microbial activities were observed which might be traced back to short-term sedimentation events. The high microbial incorporation of leucine and thymidine during winter demonstrated that the nutrient supply, rather than temperature, is the dominating factor determining microbial production. Stimulation of microbial activities arose from the sediment surface and spread out relatively quickly into deeper horizons. Generally, the sediments were characterized by distinct patterns of interrelaionships between the individual parameters of microbial activities measured. (Author's abstract)
W88-04080

DISTRIBUTION OF INDICATOR BACTERIA AND VIBRIO PARAHAEMOLYTICUS IN SEWAGE-POLLUTED INTERTIDAL SEDIMENTS,
Massachusetts Univ. at Boston. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-04081

SUBTIDAL MACROALGAL COMMUNITIES IN THE D'ENTRECASTEAUX CHANNEL, TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
J. C. Sanderson, and D. P. Thomas.
Australian Journal of Ecology AJECDQ, Vol. 12, No. 1, p 41-51, March 1987. 8 fig, 4 tab, 15 ref.

Descriptors: *Marine algae, *Tasmania, *Species composition, *Regression analysis, Hydrologic data collections, Benthic flora, Macrophytes, Water depth, Light penetration, Wave action, Substrates, Water temperature, Ecosystems, Population density.

Community descriptions and distributions of the dominant subtidal macroalgae were recorded for the D'Entrecasteaux Channel, Tasmania. These were related to the major environmental parameters of light, water movement, substrate and depth. Six communities were recognized subjectively: (1) Durvillaea, (2) Phyllospora, (3) Macrocystis, (4) Ecklonia, (5) Fucoid and (6) Seagrass-Caulerpa. These divisions were supported by cluster analysis of data from Tinderbox, a site at the northern end of the Channel. Detrended correspondence analysis of community data suggested that light was the principal factor (Axis 1), followed by water movement, in determining species distributions at Tinderbox. The algal communities determined are consistent with the generalized scheme proposed by Edgar (1984) for this area and are indicative of cold temperate waters and the Maugean subprovince. (Author's abstract)
W88-04086

BENZTHIAZOLES IN ESTUARINE SEDIMENTS AS INDICATORS OF STREET RUNOFF,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-04095

MERCURY CONTENT IN THE WATER AND MARINE ORGANISMS IN ANGKE ESTUARY, JAKARTA BAY,
Indonesian Inst. of Sciences, Djakarta. Lab. of Environmental Study.
For primary bibliographic entry see Field 5B.
W88-04148

PERSISTENCE AND MOVEMENT OF ATRAZINE IN A SALT MARSH SEDIMENT MICROECOSYSTEM,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
For primary bibliographic entry see Field 5B.
W88-04152

INTERTIDAL ZONATION AND SEASONALITY OF MEIOBENTHOS IN TROPICAL MANGROVE ESTUARIES,
Australian Inst. of Marine Sciences, Townsville.
D. M. Alongi.
Marine Biology MBIOAJ, Vol. 95, No. 3, p 447-458, August 1987. 1 fig, 6 tab, 41 ref.

Descriptors: *Estuaries, *Population dynamics, *Intertidal areas, *Seasonal variation, *Meiobenthos, Mangrove swamps, Populations, Distribution, Tropical regions, Australia, Correlation analysis, Temperature effects, Distribution patterns, Monsoons, Meiofauna, Population density.

Intertidal zonation and seasonality of tropical meiobenthic communities were examined within five mangrove estuaries along the northeastern

coast (Cape York peninsula) of Australia from May 1985 to January 1986. Partial correlation analysis revealed that environmental cues such as temperature and sediment granulometry were the most important factors regulating the zonation patterns of meiofauna. Seasonality was greatly influenced by monsoonal rains. During austral summer, prolonged monsoonal rains occurred along the coast north of 18 degrees S latitude, resulting in increased river discharge and scouring of surface silts and clays, organic matter and bacteria from most tidal sediments. Despite scouring, meiofaunal densities increased in the summer wet season, probably due to warmer temperatures and the high resilience of meiobenthos to sediment disturbance. In mangrove sediments not subjected to torrential rains, meiofaunal densities were highest in austral autumn and winter (sediment temperature: 23 to 27 degrees C) and lowest in austral spring and summer (sediment temperature: 28 to 40 degrees C). Turbellarians were the dominant meiofaunal group, accounting for 58 to 67% of total faunal densities which generally decreased with elevation in all of the estuaries. Meiofauna in tropical Australian mangroves, as in other organic-rich muds and coral reefs, appear to exert little impact on microbial standing stocks when intercorrelated variables are accounted for. The abundances of hard-bodied meiofauna were low compared with temperate communities, lending further support to an earlier contention that tropical intertidal communities are subjected to greater physical stress than their temperate counterparts. (Author's abstract)
W88-04157

SPATIO-TEMPORAL VARIABILITY OF CHAETOZONE SETOSA (MALMGREN) POPULATIONS ON AN ORGANIC GRADIENT IN THE BAY OF BREST, FRANCE,
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
C. Hily.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 112, No. 3, p 201-216, November 3, 1987. 6 fig, 2 tab, 34 ref.

Descriptors: *Chaetozone setosa, *Bay of Brest, *France, *Ecosystems, Species diversity, Population density, Water pollution effects, Organic matter, Sediments.

Chaetozone populations were studied live under various conditions of organic enrichment, but in only one type of sediment (sandy mud). Each population variable was related to the density and individual mean weight (IMW). The optimal ecological area corresponded to maximum density (500-1500 ind/0.1 sq m) and maximum IMW (0.7 mg) throughout the year. This area is in the polluted zone of the harbor of Brest (10-11% organic matter). The boundaries of the potential ecological area are defined: temporary population and low IMW (0.2 mg) corresponding to the normal zone (5-7% organic matter). Each population (recruitment, mortality) has particular dynamics different from each other and from year to year. The local conditions of granulometry and organic mining the differences between the populations, in terms of recruitment, densities, and biomass. (Lantz-PTT)
W88-04167

DIURNAL VARIATIONS OF INTRACELLULAR NITRATE STORAGE BY MARINE DIATOMS: EFFECTS OF NUTRITIONAL STATE,
Centre d'Oceanologie de Marseille (France).
P. Raimbault, and M. Mingazzini.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 112, No. 3, p 217-232, November 3, 1987. 6 fig, 1 tab, 50 ref.

Descriptors: *Diatoms, *Marine environment, *Diurnal variations, *Nitrates, Nitrogen, Nutrients, Essential nutrients, Light.

Nitrate uptake and accumulation were measured in N-sufficient, N-limited, and 25 hr N-starved cells of Phaedactylum tricornatum Bohlin and Skeletonema costatum Grev., growing under a light-dark cycle. In N-sufficient cells the uptake rate was reduced at night and showed possible variation during the light period. In N-limited and N-starved cells such diurnal changes in uptake were absent, except that extremely rapid but short-lived nitrate uptake was observed early in the morning in N-limited cells. The nitrate accumulation inside the cells reflects a transient uncoupling between uptake and reduction mostly due to the light-dark cycle and strongly influenced by the physiological state of the cells. This accumulation is high during the night and at the beginning of the day, but decreases during the light period in N-sufficient cells. On the other hand, nitrate storage in N-sufficient and N-limited cultures shows a strong diurnal pattern, with maximum accumulation, suggesting the greatest uncoupling between uptake and assimilation, in the morning. In N-starved cells, accumulation is high and constant during the entire light period. Consequently, the uncoupling between nitrate uptake and reduction decreases during the light period but increases with N deficiency. These results indicate the importance of light periodicity and nutritional state of the cells on the nitrate utilization. They reveal the need for more systematic studies on N dynamics in relation to nutrient-light regimes. (Author's abstract)
W88-04168

PHOTOSYNTHETIC PRODUCTS AND NUTRIENT AVAILABILITY IN PHYTOPLANKTON POPULATION FROM GOKASHO BAY, JAPAN,
Nagoya Univ. (Japan). Water Research Inst.
T. Hama, and T. Honjo.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 112, No. 3, p 251-266, November 3, 1987. 4 fig, 3 tab, 38 ref.

Descriptors: *Photosynthesis, *Nutrients, *Gokasho Bay, *Japan, *Phytoplankton, Population dynamics, Chemical analysis, Gas chromatography, Mass spectrometry, Organic carbon, Carbohydrates, Nitrogen, Light, Diurnal variation.

Weekly changes in the photosynthetic products of natural phytoplankton population in Gokasho Bay, Japan, were determined by the combined 13-C and gas chromatography-mass spectrometry (13-C-GC-MS) method. Total organic carbon production rate determined by the daytime incubation (8.5 h) ranged from 7.5 to 47 micrograms C/L/h, and from 2.3 to 17 micrograms C/L/h in the day-nighttime incubation rate in the daytime, and high values were obtained in the low inorganic nitrogen period, glucose accounted for >90% of carbohydrate production in the daytime. On the other hand, protein carbon formed 7.7-25 and 14-47% of total organic carbon production in the daytime and the day-nighttime, respectively. A high protein contribution was observed under the high nutrient concentration. These results strongly suggested that the distribution pattern of incorporated carbon was affected by nutrient availability. (Author's abstract)
W88-04169

EFFECT OF WATER FLOW ON GROWTH AND REPRODUCTION OF CELLEPORELLA HYALINA (L.) (BRYOZOA:CHEILOSTOMATA),
University Coll. of North Wales, Bangor. School of Animal Biology.
For primary bibliographic entry see Field 2H.
W88-04171

POSSIBLE MECHANISMS UNDERLYING COPEPOD GRAZING RESPONSES TO LEVELS OF TOXICITY IN RED TIDE DINOFLAGELLATES,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
J. D. Ives.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 112, No. 2, p 131-145, October 27, 1987. 4 fig, 1 tab, 28 ref.

Descriptors: *Toxins, *Copepods, *Toxicity, *Red tide, *Dinoflagellates, Laboratory analysis, Biological studies, Physiology, Ecology.

A previous study indicated that rates of ingestion exhibited by adult female copepods of Acartia hudsonica (Pinhey) and Pseudocalanus spp. were lowered by increasing levels of toxicity in clonal cultures of the bloom-causing dinoflagellate Protogonyaulax tamarensis (Taylor). In the present study, three types of laboratory grazing experiments were performed to determine which of two contending hypotheses - behavioral rejection or physiological incapacitation - could explain the observed relationship best. The experimental results consistently supported the postulated mechanism of physiological incapacitation, and not the mechanism of behavioral rejection, as the reason for the lowered rates of ingestion on the more toxic dinoflagellate clones. (Author's abstract)
W88-04172

HYDROLOGIC PARAMETERS OF SALT MARSH PEAT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
J. F. Knott, W. K. Nuttle, and H. F. Hemond.
Hydrological Processes, HYPRE3, Vol. 1, No. 2, p 211-220, March 1987. 5 fig, 20 ref. NOAA Grant No. 04-7-158-44079, and NSF Grant No. BSR-8306433.

Descriptors: *Salt marshes, *Peat, *Hydrologic properties, *Massachusetts, Marshes, Permeability coefficient, Great Sippewissett Marsh, Ebben Creek Marsh, Bogs, Wetlands.

Because of their profound influence on water movement and nutrient cycling in salt marshes, hydraulic conductivity and compressibility were studied in the Great Sippewissett Marsh and in the Ebben Creek Marsh in Massachusetts. Hydraulic conductivity was the most variable property: most frequently observed conductivities were of the order of 0.001 cm/sec in both marshes, but extremes ranged from about 0.1 to 0.00001 cm/sec. Compressibility was much less variable, and contributed of the order of 0.001/cm to the specific storativity of marsh sediment, making compression a major mechanism for changes in water storage in the sediment. Surface sediments frequently exhibited below-average conductivity, in contrast to freshwater bog peats which are usually most conductive at the surface. These measured properties may be applied to estimate the importance of many critical processes, such as the extent of infiltration occurring on the marsh surface, the hydrologic influence of the tidally varying creeks, and the hydrologic response to spring-neap tide cycles. (Author's abstract)
W88-04245

SINK OR DRAIN: A SIMULATION STUDY OF FACTORS AFFECTING THE ROLE OF AN ESTUARY SUBJECT TO TOXIC INPUTS,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5B.
W88-04261

VARIABLE DENSITY FLOW AND SOLUTE TRANSPORT SIMULATION OF REGIONAL AQUIFERS CONTAINING A NARROW FRESHWATER-SALTWATER TRANSITION ZONE,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W88-04306

PRESSURE CHANGE AND SURFACE EXPANSION IN SALT MARSHES DUE TO TIDAL INUNDATION,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
M. Y. Corapcioglu, and S. Mathur.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1996-2000, October 1987. 4 fig, 1 tab, 23 ref, append.

Descriptors: *Tidal floods, *Tidal effects, *Salt marshes, *Pore pressure, *Surface expansion, Water pressure, Marshes, Water table, Flooding, Mathematical models, Model studies, Mathemati-

cal studies, Infiltration, Estuaries, Soil moisture retention, Soil water suction.

Infiltration of water across the surface-water interface of a marsh in areas flooded due to tides has been known to cause swelling of sediments. The sudden tidal inundation in an unflooded soil creates a head gradient at the surface of the unsaturated soil above the water table. When water infiltrates into the soil under this gradient, the suction head in the unsaturated domain decreases, and the pore pressure in the saturated zone increases with time, resulting in swelling of highly compressible marsh soils. A one-dimensional mathematical model which consists of a mass conservation equation, quasi-static equilibrium equations, stress strain relations for an assumed perfectly elastic solid matrix and a variable total stress expression was employed to obtain a numerical solution for pore pressure change and swelling due to tidal inundation. Numerical results are presented graphically at the spatial and temporal points of interest for a constant depth of ponding water at the marsh surface resulting from tidal inundation. Results show that swelling of soil is primarily governed by the initial head gradient across the marsh surface-water interface. (Author's abstract)
W88-04321

VARIATIONS IN SHELL GROWTH AND IN AGE STRUCTURE OF MACOMA BALTHICA (L.) IN AN INTERTIDAL POPULATION OF THE SAINT LAWRENCE ESTUARY (VARIATIONS DE LA CROISSANCE DE LA COQUILLE, ET DE LA STRUCTURE D'AGE DU BIVALVE MACOMA BALTHICA (L.) DANS UNE POPULATION INTERTIDALE DE L'ESTUAIRE SAINT-LAURENT (QUEBEC)),
Quebec Univ., Rimouski. Dept. of Oceanography.
B. Vincent, C. Brassard, and M. Harvey.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 8, p 1906-1916, August 1987. 7 fig, 7 tab, 45 ref.

Descriptors: *Mollusks, *Intertidal areas, *Temperature effects, *Estuaries, *Variability, Adaptation, Tides, Mortality, Phenology, Growth rates, Saint Lawrence River, Tidewater.

Greater annual shell growth rate and increased mortality are observed in Macoma balthica (L.) with an increase of immersion time in the intertidal zone of the St. Lawrence estuary. There is also a greater annual growth rate in tidal pools, and sediment temperature alone may explain spatial variations in spring and annual growth. Reciprocal transfers of specimens between upper (0.8 m above mean water level) and lower (1.2 below mean water level) tidal level result in enhanced shell growth for individuals of the upper level transferred to the lower level. There is no corresponding change of shell growth rate for individuals of the lower level. This genotypic difference in short-term physiological responses to environmental changes may be the result of different selective pressures associated with habitat temporal heterogeneity. An opportunistic strategy is associated with the more terrestrial and unpredictable environment (upper tidal level) and a more specialized strategy accompanied by low phenotypic variability is associated with the more marine and stable environment (lower tidal level). (Author's abstract)
W88-04337

SURVEY FOR SALINITY INTRUSION AND POLLUTION ASSESSMENT IN MAPUTO ESTUARY,
Universidade Eduardo Mondlane, Maputo (Mozambique). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04366

TEJO 1 - AN INTERACTIVE PROGRAM FOR THE DIVISION OF ESTUARIES INTO HOMOGENEOUS AREAS,
Universidade Nova de Lisboa (Portugal). Coll. of Sciences and Technology.
A. S. Camara, M. Cardoso da Silva, L. Ramos, and J. Gromes Ferreira.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 43-51, 1987. 7 fig, 1 tab, 6 ref.

Descriptors: *Estuaries, *Model studies, *Water resources development, *Computer models, *Water quality management, Algorithms, Hydrologic models, Source of pollutants, Management planning.

The division of an estuary into homogeneous areas from both hydrodynamic and ecological standpoints is essential to any estuarine basin management model. Presented here is an approach based on a heuristic algorithm to achieve such a division. The methodology implemented through an interactive computer program named Tejo 1 applies morphological, water quality and management criteria in order to achieve the disaggregation. The approach is equally applicable to river or lake basins, with only minor adaptations. An application of Tejo 1 to the Tejo estuary is included for illustrative purposes, which resulted in the final division of the estuary into 11 homogeneous areas. (Author's abstract)
W88-04416

TOWARDS CONTROL OF AN ESTUARY,
Ministry of Transport and Public Works, The Hague (Netherlands).
H. L. F. Saeijs.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 155-174, 1987. 12 fig, 5 tab, 25 ref.

Descriptors: *Estuaries, *Dam effects, *The Netherlands, *Environmental impact statement, *Environmental effects, Ecological effects, Dam construction, Salt marshes, Biomass, Tidal flats, Marine animals, Marsh plants, Marsh management, Land use, Management planning.

The Delta Project, which was subject to political reconsideration in 1974, is scheduled for completion in 1987. The final touches are being put to the storm-surge barrier and two compartment dams that divide the Oosterschelde into three areas: a tidal area, a reduced tide area, and a freshwater lake. Compartmentalization will result in the loss of 13% of the channels, 45% of the intertidal flats and 59% of the salt marshes. There is a net gain of 7% of shallow-water areas. Human interventions with large scale impacts are taking place in shorter time periods in the Oosterschelde. In the controlled tidal system, the area with reduced tide is compared to present day and expected characteristics. In the reduced tidal area, salt marshes will extend by 30-70%; intertidal flats will erode to a lower level and at their edges, and the area of shallow water will increase by 47%. Biomass production on the intertidal flats will decrease, with consequences for crustaceans, fish and birds. The number of waders will decrease drastically, with negative effects for the wader populations of western Europe. The net area with a hard substratum in the reduced tidal part has more than doubled. Channels will become shallower, and detritus import will not change significantly. Stratification and oxygen depletion will be rare and local. The operation of the storm-surge barrier and the closure strategy chosen are very important for the ecosystem. Two optional closure strategies can be followed without any additional environmental consequences. Determination of a clearly defined plan of action for the whole area and how land-use choices were made are briefly described. (Author's abstract)
W88-04428

MATHEMATICAL MODELS FOR MIXING AND DISPERSION IN FORECASTING AND MANAGEMENT OF ESTUARINE WATER QUALITY,
Calcutta Metropolitan Development Authority (India).
S. K. Bose, P. Ray, and B. K. Dutta.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 183-193, 1987. 64 ref.

Descriptors: *Mathematical models, *Estuaries, *Water quality, *Mixing, *Suspended solids, Tracers, Model studies, Turbulent flow, Flow velocity, Rivers, Correlation analysis, Flow rates, Water quality management.

The dispersion or spread of a dissolved or suspended substance in an estuarine system occurs mainly due to the non-uniformity of velocity distribution, including turbulent fluctuations, shear stress at the boundary and surface stress caused by winds. The mixing and dispersion phenomena in rivers and estuaries are extremely important in water quality management and control. The development of a dispersion model in harmony with the nature of the flow field in a river or estuary is necessary in the estimation and correlation of dispersion parameters, called dispersion coefficients, which may be anisotropic in a multidimensional transport process. The earlier one-dimensional models have gradually given way to higher dimensional models for better description of the phenomena as well as for the more accurate estimation of parameters. Field studies of dispersion of tracers have been the most important method of generating data for parameter estimation. A number of correlations for mixing and dispersion coefficients in terms of flow rates and other fundamental system parameters are available. The present study incorporates the analysis, assessment and applications of various dispersion and mixing models available. Also, a critical appraisal of the validity, inherent degree of uncertainty and the range of applications of different correlations has been incorporated. (Author's abstract)
W88-04430

TWO-LAYER MODEL OF SALINE WEDGE. I: ENTRAINMENT AND INTERFACIAL FRICTION,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
M. Arita, and G. H. Jirka.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1229-1248, October 1987. 8 fig, 33 ref, 3 append.

Descriptors: *Saline-freshwater interfaces, *Estuaries, *Saline water intrusion, *Model studies, *Entrainment, Kinetics, Hydrologic models, Mathematical models, Saline water.

The arrested saline wedge geometry is characterized by two major internal demarcation lines, the density interface and the zero velocity line (ZVL). As a complement to earlier two-layer model formulations that are based upon the density interface, a two-layer model using the ZVL was developed. The advantage of this model is that it divides the flow into an active upper zone with high kinetic energy content and a passive lower zone as suggested by detailed experiments. Net entrainment across the ZVL drives the flow in the passive salt zone. An entrainment model was developed on the basis of stability theory and similarity theory for turbulent buoyant shear flows but includes an empirical transition to purely laminar flow in the low Reynolds number range. The model depends on two local parameters, a bulk Richardson number (or densimetric Froude number) and a bulk Reynolds number. Predicted entrainment rates agree well with available data over the range of parameters. The model can be extended to predict the interfacial shear in the complementary formulation that is based on the density interface and, again, shows good agreement with published data. (See also W88-04462) (Author's abstract)
W88-04461

TWO-LAYER MODEL OF SALINE WEDGE. II: PREDICTION OF MEAN PROPERTIES,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
M. Arita, and G. H. Jirka.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1249-1263, October 1987. 12 fig, 12 ref, append.

Descriptors: *Saline-freshwater interfaces, *Estuaries, *Saline water intrusion, *Model studies, Prediction, Entrainment, Mathematical models, Hydrologic models.

The theoretical formulations developed in part 1 for entrainment at the zero velocity line (ZVL) and for interfacial friction of the density interface

have been implemented in a two-layer model of the arrested salt wedge. Assuming constant densities in each layer, the equations were integrated numerically to predict overall wedge properties, including total intrusion length, the strength of salt circulation, wedge shape, and critical exit conditions. Good agreement was found with available data spanning the full Reynolds number range from laboratory to field conditions with relative intrusion lengths between orders 10 - 10 to the 4th. This supports the theoretical development of part 1. Furthermore, the model documents the important of including in wedge analysis the lower-layer dynamics (bottom shear stress and convective effects). (See also W88-04461) (Author's abstract)
W88-04462

EXPERIMENTS ON SALINE WEDGE,
Coastal Engineering Research Center, Vicksburg, MS.
F. E. Sargent, and G. H. Jirka.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1307-1324, October 1987. 12 fig, 1 tab, 20 ref, append. DOE Contract No. ET-78-S-02-4683, and NSF Grant No. CME-8012682.

Descriptors: *Saline-freshwater interfaces, *Estuaries, *Saline water intrusion, *Internal flow, *Hydrodynamics, Flow profiles, Mathematical studies, Flow velocity, Fluid mechanics, Saline water, Density stratification.

Detailed measurements on the internal flow structure of the arrested saline wedge over a horizontal bottom were performed together with observations of its overall appearance. The experiments covered a channel Reynolds number range between 4,000 and 10,000 and a densimetric Froude number range between 0.39 and 0.49. Measurements included overall shape, internal circulation, velocity, density and gradient Richardson number profiles, entrainment rates, and shear stresses. The major portion of the saline wedge, excluding the wedge tip and the exit regions, is a quasi-equilibrium region in which internal flow properties are nearly similar. The flow dynamics are controlled by the turbulent freshwater overflow with a downward cascading process of energy toward the salt layer. Conditions at the two major internal dividing lines, the density interface and the zero velocity line, were elucidated. The density interface is a highly stable zone with intermittent wave breaking, mixing, and entrainment. The zone is a state of marginal instability consistent with linear stability theory. Viscous and turbulent shear stresses are of about equal magnitude at the interface, while the net upward entrainment is small. The zero velocity line, in contrast, experiences a large upward entrainment of salt water but has small shear stresses. (Author's abstract)
W88-04466

IDENTIFICATION OF MICRODETRITUS DERIVED FROM SPARTINA AND ITS OCCURRENCE IN THE WATER COLUMN AND INTERTIDAL SEDIMENTS OF CUMBERLAND BASIN, BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
P. J. Cranford, P. Schwinghamer, and D. C. Gordon.
Estuaries ESTUDO, Vol. 10, No. 2, p 108-117, June 1987. 4 fig, 2 tab, 31 ref.

Descriptors: *Spartina alterniflora, *Intertidal sediments, *Bay of Fundy, *Aquatic vegetation, Aquatic environment, Ecosystems, Estuaries, Salt marshes, Organic carbon, Primary productivity.

A cellulose-specific staining procedure employing Herzberg's chlor-zinc-iodide solution was developed to aid in the identification of microdetritus derived from Spartina alterniflora and tested on samples of suspended and sedimented particulate matter collected in the Cumberland Basin at the head of the Bay of Fundy. Not all of the particles reacting positively to the stain could have been identified as originating from Spartina on the basis of morphology alone, and the stain improved speed and confidence in identification even when particles could be identified morphologically. Spartina dominated particles greater than 100 micrometers while most of the smaller particles were amorphous aggregates of uncertain origin. In April 1985, at the start of the salt-marsh growing season, the average concentration of suspended microdetritus derived from Spartina in Cumberland Basin surface water was 129 mg C/cu m or 0.3-2.7% of the particulate organic carbon. The average concentrations in intertidal sediments was 0.036 mg C/gm or 0.2-0.9% of the sediment organic carbon. Summing all reservoirs in the sediment (to a depth of 1 cm) and water column, the total amount of detritus originating from Spartina in Cumberland Basin is 10-24% of the estimated annual net primary production of low marsh S. alterniflora. (Author's abstract)
W88-04478

EXCHANGE OF MICROBIAL BIOMASS BETWEEN A SPARTINA ALTERNIFLORA MARSH AND THE ADJACENT TIDAL CREEK,
Texas Univ. at Arlington. Dept. of Biology.
T. H. Chrzanowski, and J. D. Spurrier.
Estuaries ESTUDO, Vol. 10, No. 2, p 118-125, June 1987. 3 fig, 3 tab, 22 ref. NSF GRant Nos. DEB 8119752 and DEB 8012165.

Descriptors: *Biomass, *Microbiological studies, *Spartina alterniflora, *Aquatic vegetation, *Salt marshes, *Estuaries, Tidal flooding, Marsh plants.

Salt marsh systems of the southeastern United States are characterized by extensive strands of Spartina alterniflora. These marshes may influence the concentrations of material suspended in flooding and receding tidal waters. The ability of S. alterniflora-dominated marsh to influence the concentration of suspended microbial biomass was investigated through the use of 142-m long flume. The flume extended through stands of tall-, medium-, and short-height Spartina. Water passing through the tall Spartina lost a considerable portion of microbial biomass. Initial samples from medium-height Spartina were collected from water that had already passed through the tall grass. These samples contained 20 to 70% less microbial biomass than did water entering the tall Spartina. Calculations of mass transport suggest that the tall Spartina zone of marsh acts as a sink for microbial biomass while the short-height Spartina tends to export biomass (to the tall Spartina zone). The marsh as a whole acts as a sink for microbial biomass. Transport estimates from 32 individual tide cycles were modeled to obtain an annual estimate of transport. As a conservative variability among individual transport estimates, no annual transport estimate could be distinguished from a net-zero transport. (Author's abstract)
W88-04479

DISTRIBUTION AND ABUNDANCE OF TIDAL MARSHES ALONG THE COAST OF MAINE,
Maine Univ. at Orono. Inst. for Quaternary Studies.
H. A. Jacobson, G. L. Jacobson, and J. T. Kelley.
Estuaries ESTUDO, Vol. 10, No. 2, p 126-131, June 1987. 3 fig, 2 tab, 18 ref.

Descriptors: *Tidal marshes, *Maine, *Maps, Estuaries, Coastal waters, Productivity, Salt marshes, Geography.

Planimetry studies of coastal geology maps prepared by the Maine Geological Survey show that there is more than an order of magnitude more tidal marsh area in the state of Maine than documented in previously published estimates. The highly convoluted coast of Maine, which is approximately 5,970 km long, contains almost 79 sq km of salt marsh, far more than any other New England state, New York, or the Bay of Fundy region. Reasonable estimates for the per-unit primary productivity of salt marshes lead to projections of total marsh productivity on the order of 10 to the 10th power gm dry weight/yr for the Maine coast and 10 to the 11th power gm dry weight/yr for the Gulf of Maine as a whole. Distribution of tidal marsh area is strongly controlled in the southwestern coastal region of arcuate bays, where marshes have developed behind sandy beaches. A series of long islands and bedrock peninsulas in the south-central portion of the coast also provides sheltered areas where large marshes occur. Northeast of Penobscot Bay salt marshes become more numerous and smaller in average areal extent. A lack of protection from waves, along with limited sources of glacio-fluvial and glacio-marine sediments, restricts the occurrence of salt marshes in that region to the fringes of coves and tidal rivers. (Author's abstract)
W88-04480

COMPARATIVE STUDY OF THE MOLLUSC COMMUNITIES OF TWO OLIGOHALINE INTERTIDAL MARSHES: SPATIAL AND TEMPORAL DISTRIBUTION OF ABUNDANCE AND BIOMASS,
Georgia Univ., Athens. Inst. of Ecology.
T. D. Bishop, and C. T. Hackney.
Estuaries ESTUDO, Vol. 10, No. 2, p 141-152, June 1987. 7 fig, 6 tab, 49 ref. Mississippi Bureau of Marine Resources Project No. GR-ST-79-005.

Descriptors: *Mollusks, *Intertidal marshes, *Salt marshes, *Biomass, Temporal distribution, Comparative studies, Salinity, Ecosystems, Hydrogen ion concentration, Organic matter, Species diversity, Population distribution, Primary productivity.

Mollusks were collected monthly for a year from two low salinity (0-90%) intertidal marshes dominated by the macrophytes Juncus roemerianus or Spartina cynosuroides in St. Louis Bay, Mississippi. The Juncus marsh had lower soil organic matter, higher pH and was more frequently inundated than the Spartina marsh. Eight species of gastropods were abundant and dominated in the higher Spartina marsh, while three bivalve species were dominant in the Juncus marsh. Of the common species, Succinea ovalis, Vertigo ovata and Deroceras laeve are gastropods of terrestrial origins; Geukensia demissa granosissima (bivalve) and Melampus bidentatus (gastropod) are euryhaline estuarine species and the remaining gastropods are brackish species. Most species were capable of continuous recruitment (based on size class analysis), but exhibited peak activity in particular seasons. Bivalve abundance correlated to temperature, and gastropod abundance was negatively correlated to soil pH. These correlations reflect the influence of flooding regime at the two sites. Biomass was greater in the Juncus marsh because of the increased presence of the large-bodied Polymesoda. Polymesoda represented $>90\%$ and $>50\%$ of the total biomass in the Juncus and Spartina (except summer) marshes respectively but always $<$ or $=$ 5% of the individuals collected. Gastropod biomass was the same in both marshes. Species diversity was greater in Spartina except for summer months. The Juncus marsh always exhibited greater species richness. Evenness determined seasonal changes in diversity. Similarity values were always quite low, with highest values in spring. In contrast to faunal studies from Gulf and East Coast salt marshes, this study found: (1) fewer species; (2) communities comprised of unique species combinations; (3) greatest mean densities in summer, and (4) potentially less productivity by the mollusks of the sites. These mollusk communities exhibit structural characteristics that emphasize the unique ecotonal nature of the oligohaline marshes within which they are found. (Author's abstract)
W88-04482

CATTAIL INVASION AND PERSISTENCE IN A COASTAL SALT MARSH: THE ROLE OF SALINITY REDUCTION,
Army Engineer District, Los Angeles, CA.
P. A. Beare, and J. B. Zedler.
Estuaries ESTUDO, Vol. 10, No. 2, p 165-170, June 1987. 2 fig, 2 tab, 22 ref. NOAA Grant No. NA80AA-D-00120, and Project Nos. R/NP-13BB and R/CZ-73.

Descriptors: *Cattails, *Salt marshes, *Salinity, Tidal marshes, Saline soils, Germination, Aquatic plants, Seedlings.

The hypothesis that Typha domingensis (cattail) can invade tidal marshes only after soil salinities

are substantially reduced was tested experimentally by comparing the salt tolerance of seeds, seedlings, and plants reared from rhizomes. Germination rates for four southern California populations reached 100% in fresh water, decreasing to 2% at 20 parts per thousand. The salt tolerance of seeds from three coastal populations was lower than that of the Salton Sea population. Salt tolerance of plants grown in the lab did not increase with age for seedlings up to 8 weeks old. Rhizome-bearing plants had greatly decreased growth at 10 parts per thousand and no growth at 25 parts per thousand. However, rhizomes of about 5% of the plants survived 9 months at 45 parts per thousand. The seeds and seedlings are salt sensitive, which explains why invasion into tidal marshes is restricted to prolonged periods of low soil salinity. The older, rhizome-bearing plants are salt tolerant, which explains how invading plants persist under hypersaline conditions. (Author's abstract)
W88-04483

GREEN ALGAL ROPES: A NOVEL ESTUARINE PHENOMENON IN THE GULF OF MAINE,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
R. L. Vadas, and B. Beal.
Estuaries ESTUDO, Vol. 10, No. 2, p 171-176, June 1987. 6 fig, 1 tab, 35 ref. The Maine Sea Grant Program NA-81-aa-D-00035.

Descriptors: *Estuaries, *Algae, *Gulf of Maine, *Algal ropes, Seasonal variation, Algal blooms.

During late summer and early autumn of both 1984 and 1985 the development of a green algal bloom on intertidal mudflats in eastern Maine were observed and photographed. The bloom culminated in the formation of thick (8-10 cm) mats and long (>50 m) serpentine rope-like structures. The algal mat was polytypic but composed primarily of Enteromorpha intestinalis L. Described is the probable sequence of events which leads to the formation of algal ropes. The processes involved appear to parallel the development of ball-like masses in other algae. Algal ropes developed after mat formation, as prevailing winds and tidal currents rolled individual and entwined strands across the mudflat. The great mass of algae eventually became embedded into the sediment surface producing anoxic conditions in the substrate up to several cm deep. The ecological significance and possible negative effects of this altered environment on a commercially important bivalve species are discussed. (Author's abstract)
W88-04484

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

INTERIM PROGRESS REPORT SCPP FORECASTING SUPPORT: FOR PERIOD 1 SEPTEMBER 1983-31 AUGUST 1984, VOLUME II,
Electronic Techniques, Inc., Fort Collins, CO.
J. O. Rhea, A. W. Huggins, G. L. Hemmer, A. P. Kuciauskas, and C. J. Wilcox.
Bureau of Reclamation, Denver, CO. Division of Atmospheric Resources Research. 322 p, 239 fig. Contract No. 9-07-85-V0021.

Descriptors: *Cloud seeding, *Forecasting, *Orographic precipitation, *Artificial precipitation, Weather modification, Project Skywater, Radar, Remote sensing, Sierra Nevada.

This report is the last in a series of six interim reports on the Sierra Cooperative Pilot Project, a winter cloud-seeding research study. It summarizes activity in support of the SCPP for the period 1 September 1983-31 August 1984. Volume I describes field services and presents various analyses. Volume II contains time-height sections of Sheridan rawinsonde information, map sets, plotted soundings, satellite pictures, and discussions of conditions for each of 13 experiment days of 1984. Field services included project forecasting, rawinsonde observations, 24 hour operation of the Skywater radar, and aircraft coordination from the radar site. Analysis summaries were partitioned into general categories of Radar, Targeting studies, Special rawinsonde cross-section and General support. Radar descriptions of 4 unseeded 1982 SCPP-1 events indicated fairly consistent SCPP-1 conditions for >3 hr periods, but shifting formation zone (FZ) locations required repositioning of seeding lines. The FZ's over 1000 ft terrain were unusually low. Analysis of radar echoes and supercooled liquid water (LW) observations for 4 days in relatively stable, apparently seedable conditions indicated (a) relatively warm cloud and echo tops (> -17C), (b) significant LW observations concentrated in weakest regions at temperatures > -5C, (c) variable natural echo patterns frequently complicated by bands and fallstreaks, and (d) serious difficulty in (5 cm radar) detection of seeding effects due to inhomogeneities of echo pattern and LW regions. Continuing studies of the targeting problem are described, including (a) adaptation of the original targeting scheme for real-time experimental use with winds from either Sheridan soundings or project aircraft, (b) modifications of the scheme to allow time-height display of simulated passage of a group of 'crystals' over fixed points downwind of seeding as might occur from a drop of CO2 pellets, assuming crystals with a variety of fallspeeds were created simultaneously at various levels along the seeding line, and (c) comparisons between model and observed winds. (Author's abstract)
W88-03948

3C. Use Of Water Of Impaired Quality

BEHAVIOR OF SOLUBLE SALT IN SHARKEY CLAY-II,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
J. T. Gilmour, R. E. Baser, J. A. Ferguson, and H. D. Scott.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149290/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 123, June 1986. 19 p, 8 tab, 18 ref. Contract No. 14-08-0001-G1004. Project No. USGS G1004-03.

Descriptors: *Soil salinity, *Irrigation effects, *Rice, *Arkansas, *Flood irrigation.

Soluble salts have been shown to accumulate in Arkansas soils in sufficient quantities to impair crop plant growth. The major objective of this study was to describe the behavior of soluble chloride salt over long time periods in Sharkey clay - a major Mississippi Delta soil. Prior to flooding rice, leaching of chloride in response to rainfall was observed. The inclusion of a sandy subsoil layer reduced this effect presumably by limiting downward movement of water under unsaturated conditions. No lateral movement of the chloride salt was found during the period prior to flooding. Removal of soluble chloride salts from the top 100 cm of Sharkey soil was complete in a 1-2 year period depending on weather conditions. In a year where the rice cropping season was followed by a wet winter, losses were smaller than in a year where the rice cropping season was followed by a drier winter. These results suggested that removal of soluble salts via leaching in this soil was more efficient under less saturated soil conditions. (USGS)
W88-03500

EPIDEMIOLOGICAL MODEL OF THE POTENTIAL HEALTH RISK ASSOCIATED WITH VARIOUS PATHOGENS IN WASTEWATER IRRIGATION,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W88-03581

PROSPECTIVE EPIDEMIOLOGICAL STUDY OF HEALTH RISKS ASSOCIATED WITH WASTEWATER UTILIZATION IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W88-03582

MICROBIOLOGICAL CONTENT AND HEALTH EFFECT OF FISHPONDS ENRICHED WITH WASTEWATER EFFLUENT,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 8I.
W88-03583

VIRAL ANTIBODIES IN AGRICULTURAL POPULATIONS EXPOSED TO AEROSOLS FORM WASTEWATER IRRIGATION DURING A VIRAL DISEASE OUTBREAK,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5B.
W88-03672

TRICLOPYR PERSISTENCE IN WESTERN OREGON MILL PASTURES,
Oregon State Univ., Corvallis. Dept. of Forest Science.
For primary bibliographic entry see Field 5B.
W88-03701

SALT INCREASES THE WATER USE EFFICIENCY IN WATER STRESSED PLANTS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. J. McCree, and S. G. Richardson.
Crop Science CRPSAY, Vol. 27, No., p 543-547, May-June 1987. 3 fig, 2 tab, 11 ref. NSF Grant PCM 82-13089.

Descriptors: *Water stress, *Water use efficiency, *Plant water use, *Salts, *Salt tolerance, *Irrigation, Food crops, Sugarbeets, Cowpeas, Crop yield.

Irrigated crops experience some water stress between irrigations. If poor quality water is used, the crops are also likely to be salinized. Daily C gains and water losses of salinized and nonsalinized sugarbeet (Beta vulgaris L.), and cowpea (Vigna unguiculata L. Walp.) plants were measured continuously, in whole-plant assimilation chambers, throughout 2 to 3 weeks of water stress under controlled environment conditions. Equivalent data for sorghum plants (Sorghum bicolor (L.) Moench.) were published previously. Even though the three species showed quite different patterns of response to water stress, mild salinization always had the same effect. It reduced the water loss rate per plant, which allowed the length of the irrigation cycle to be increased, which allowed the length of the irrigation cycle to be increased, which in turn increased the C gain per cycle and the water use efficiency (C gain per unit of water lost). (Author's abstract)
W88-03751

TREATED SEWAGE FINDS FRUITFUL USE,
C. Cravens.
Engineering News Record ENREAU, Vol. 218, No. 9, p 27, February 1987.

Descriptors: *Irrigation, *Water reuse, *Florida, *Recycled Water, *Waste water treatment, Orange groves, Wastewater renovation, Pipelines, Irrigation water, Infiltration.

To comply with the 1980 order of Florida's Dept. of Environmental Regulation to stop discharging secondary effluents from wastewater treatment plants the City of Orlando and Orange County conducted an evaluation of alternate means of disposal. Combined irrigation and infiltration was found to be most cost effective. The $175 million advanced wastewater treatment and distribution

system disperses 25 mgd The two treatment plants were expanded and upgraded to provide tertiary treatment. Effluent flows 20 miles through a 54 in. pipeline to a distribution center, whilch has four 20 million gal. storage tanks of prestressed concrete and a 3,000-hp pumping station. The novel use of the water is not only to irrigate the nearby orange groves free of cost but also to prevent most freezing by raising the ground temperature. Although such water has been used before this is the first time that such 72 F, 42 psi water has been used to prevent freezing. Use of this water saves the growers about 30% of their irrigation and fertilizing cost. (Ray-PTT)
W88-03815

RHIZOSPHERE MYCOFLORA OF GROUNDNUT GROWN IN SEWAGE AND SLUDGE TREATED SOILS,
Marathwada Univ., Aurangabad (India).
For primary bibliographic entry see Field 5E.
W88-03846

PLACE OF NONPOTABLE REUSE IN WATER MANAGEMENT,
California Dept. of Health Services, Berkeley.
J. Crook, and D. A. Okum.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 5, p 237-241, May 1987. 14 ref.

Descriptors: *Water reuse, *Metropolitan water management, *Reclaimed water, *Public policy, *Wastewater reclamation, *Water management, Nonpotable water, Water supply development.

Water reclamation for nonpotable reuse in municipalities is being widely adopted throughout U.S. for urban irrigation and other purposes. Communities and their engineers should consider nonpotable reuse as one of the options for evaluation when additional water resources will be developed. However, several issues need to be addressed if this practice is to continue to receive professional and public acceptance. Some of these issues are: Identification of agencies in local and state government responsible for design, planning and financing of nonpotable use of reclaimed water; Development of practices and standards for sound water use, for example, car and street washing, toilet flushing etc., so that additional high quality water is available for potable purposes and finally, National and state agencies should at least not eliminate deterrents to nonpotable reuse and preferably provide leadership in its implementation. (Ray-PTT)
W88-03850

MONITORING AND STUDY PROGRAM OF AN INTERREGIONAL WASTEWATER RECLAMATION SYSTEM FOR AGRICULTURE,
Technion - Israel Inst. of Tech., Haifa.
M. Rebhun, D. Ronen, and J. Eren.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 5, p 242-248, May 1987. 13 fig, 1 tab, 14 ref.

Descriptors: *Israel, *Wastewater reclamation, *Water reuse, *Irrigation, Monitoring, Municipal wastewater, Agriculture, Chlorination, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Phosphates, Ammonia, Irrigation water, Secondary wastewater, Effluents.

An inter-regional wastewater reclamation system uses 20 million cu m/yr of municipal effluent for irrigation of 14,000 hectares in a populated valley of northern Israel. The secondary effluent is conveyed in a closed pipe for 30 km from the municipal treatment plant of Greater Haifa to the deep Seasonal Effluent Reservoir (SER). Monitoring includes two major variables: the development and transport of odoriferous pollutants formed in the SER or released by irrigation with effluents and the transport of air-borne bacteria and viruses released during sprinkler irrigation. The closed pipe is considered a plug flow reactor where effluent chlorination and disinfection take place. In the SER many self-purification processes occur such as settling and reduction of BOD and COD. The coliform bacteria profile showed a drastic decline along the first section of the pipeline caused by chlorine disinfection but a slight increase at the end of the conduit. Additional significant reduction in coliforms took place in the SER. Chlorination of the SER outflow produced water of very good bacterial quality. Major reduction in organic matter and suspended solids (SS) also took place in the SER as well as a 50% reduction in ammonia and a 35% reduction in phosphates. The organic load on the SER entrance section was 0.2 - 0.4 kg BOD/hectare/yr declining to 0.05 - 0.1 kg BOD/hectare/yr in the second section. When water from the SER was introduced to the regional irrigation reservoir (RIR), there was a rise in the concentration of SS in the RIR and complaints of irrigation equipment clogging. It is suggested that direct supply from the SER might be more advantageous and would avoid the undesirable quality changes that take place in the RIR. (Ray-PTT)
W88-03851

INTERACTIVE EFFECTS OF WATER AND NITROGEN STRESSES ON CARBON AND WATER VAPOR EXCHANGE OF CORN CANOPIES,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W88-03875

CHARACTERIZATION, RENOVATION, AND UTILIZATION OF WATER FROM SLURRY TRANSPORT SYSTEMS,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W88-03934

REUSE OF INDUSTRIAL FERMENTATION WASTEWATERS,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
R. M. Candelario, C. C. Umana, and A. R. Gonzalez.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183174/AS. Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Final Technical Report, Mayaguez. August 1983. 48 p, 18 tab, 13 ref.

Descriptors: *Crop yield, *Land disposal, *Wastewater disposal, *Wastewater irrigation, Industrial wastewater, Wastewater renovation, Water reuse, Recycling, Soil types, Irrigation, Heavy metals, Rice, Soybeans.

The feasibility of using spent fermentation liquors from rum distilleries and from antibiotics pharmaceutical processing for agricultural purposes was investigated. The liquors were applied to different soil types using packed columns, and to rice and soybean plants grown in the greenhouse or field. Results showed that the soils reduced the contents of organic matter and N in the liquors by as much as 90% while improving their fraction of aggregates and planting properties. The presence of root systems enhanced removal of organic matter and N from the liquids and decreased the retention of cations by the soils. The pH values of the soils increased with application of liquors as their cation exchange capacity became satisfied. Commercial fertilizers gave improved yields of tissues and grains over the use of wastewaters. No buildup of Cd, Cu, Ni, or Zn occurred in the grains from wastewater-irrigated plants, but the concentration of these metals in tissues increased in most of the applications. Levels of Cd, Cu, Ni, or Zn in soils showed changes which depended on the metal, soil type, wastewater type and application amount. (Geiger-PTT)
W88-03940

SPATIAL VARIABILITY OF SOIL SALINITY IN FURROW-IRRIGATED TORRIFLUVENTS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
S. Miyamoto, and I. Cruz.
Soils Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 1019-1025, July-August 1987. 4 fig, 3 tab.

Descriptors: *Path of pollutants, *Soil salinity, *Furrow irrigation, *Saline water, *Impaired water use, Irrigation effects, Sodicity, Soil classification, Salinity.

The pattern of salt accumulation within crop beds and its spatial variation along or across crop rows was examined to develop sampling guides for routine salinity appraisal. Soil samples were collected at spacings ranging from 1.5 to 6 m in four furrow-irrigated fields of the middle Rio Grande Basin and were analyzed for salinity of the saturation extract and in selected cases for the sodium adsorption ratio (SAR). Salinity varied two to sixfold within the row lengths of 110 to 190 m, and its variation generally increased with increasing sampling depth and numbers of irrigation. The analyses of autocorrelation showed that salinity readings were spatially dependent at one of the four tested fields, and the distance of dependence reached 46 m. This field showed a gradual change in soil texture (from silty clay loam to silty clay), and provided a semivariogram conforming to a generalized linear model. When samples were collected from an area consisting of a single soil type or when salinity values were stratified by soil type, the distance of dependence decreased to < 15 m. The frequency distribution of both salinity and sodicity within the same soil type followed a normal distribution with the standard error of estimates of mostly $< 8\%$. The sampling sites required to obtain a mean value within 15% of the true mean ranged from 3 to 11 per test row when sampled at 0- to 0.20-m depth prior to preplant irrigation, and the required number increased with increasing sampling depth and numbers of irrigation. For routine appraisal of salinity in the fields similar to examined here, soil samples can be collected on the basis of soil type, and salinity data can be analyzed by conventional statistics with a reasonable assurance that salinity values are spatially independent. (Author's abstract)
W88-04043

REUSE OF DOMESTIC WASTEWATER FOR IRRIGATION IN ARID ZONES: A CASE STUDY,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
G. Oron, and J. DeMalach.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 777-783, October 1987. 2 fig, 10 tab, 23 ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Impaired water use, *Domestic wastewater, *Arid zone, Domestic wastes, Water reuse, Irrigation, Israel, Irrigation programs, Crop yield, Sprinkler irrigation, Trickle irrigation, Effluents, Crop production, Costs, Cotton, Wheat, Economic aspects.

The domestic sewage of the city of Beer-Sheva, Israel, which is located in an arid region, is treated in a series of facultative ponds. The treated effluent is stored temporarily in an open surface earthen reservoir and then used for irrigation. The effluent is applied via sprinkler and trickle irrigation systems. The main crops irrigated are cotton, wheat, alfalfa, and corn. Total cotton yield is over 5500 kilograms/hectare (kg/ha), and the wheat yield is over 7500 kg/ha. The amount of effluent applied is about 6500 cu m/ha for cotton (including preplant irrigation), and the wheat receives about 4500 cu m/ha via irrigation and an additional 2000 cu m/ha from precipitation. Due to the nutrient content in the effluent, the above yields are obtained without any additional fertilization. Applying effluent via irrigation results in an annual savings of at least 195 dollars/ha/crop. The reuse of treated domestic water in arid zones increases the amount of available water, decreases environmental pollution, and provides economic benefits. (Wood-PTT)
W88-04277

REUSE OF MUNICIPAL WASTEWATER IN ARID COUNTRIES,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Sied-

lungswasserwirtschaft.
U. Neis, F. El-Gohary, and P. Pinnow.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 681-692, 1987. 7 fig, 4 tab, 14 ref. German Ministry for Research and Technology Project No. 02 WA 112.

Descriptors: *Municipal wastewater, *Water reuse, *Arid lands, Wastewater treatment, Biological treatment, Pretreatment of water, Agriculture, Developing countries, Biological oxygen demand, Nutrients, Chemical oxygen demand, Nitrogen, Cairo.

Biological wastewater pretreatment with a rotating biological contactor is an appropriate technology to be used in developing countries for the reuse of wastewater for irrigation. Criteria for wastewater pretreatment prior to agricultural reuse were elaborated based on removal of putrescible organic matter and on balancing the nutrient composition of the effluent. Experimental investigations in Cairo led to the suggestion of a rotating biological contactor surface loading of 15 mg BOD/L as a design value to produce an effluent quality suitable for agricultural reuse. Then, 93% of the BOD and 89% of the COD is removed, eliminating easily biodegradable matter. In addition, part of the inorganic nitrogen is eliminated from the system mainly by cell metabolism and denitrification, giving a more balanced nutrient content to the effluent which should serve as irrigation water. The nitrogen removal processes under the given boundary conditions can only be explained qualitatively at present. The possible process of simultaneous nitrification/denitrification in the rotating biological contactor needs more attention. (Lantz-PTT)
W88-04353

IMPACT OF PULP AND PAPER MILL WASTEWATER ON CROP AND SOIL,
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 5E.
W88-04354

3D. Conservation In Domestic and Municipal Use

CITY TURNS TO AUTOMATIC IRRIGATION FOR ITS PARKS,
Huntsville, AL.
J. Schumacher.
Public Works PUWOAH, Vol. 118, No. 4, p 57-58, April 1987.

Descriptors: *Automation, *Irrigation efficiency, *Irrigation automation, *Water conservation, *Sprinkler irrigation, *Irrigation design, *Huntsville, Computers, Economic aspects, Irrigation engineering, Irrigation practices, Alabama, Recreation facilities, Parks.

Huntsville Parks and Recreation wanted to install automatic irrigation for its parks and playing fields to conserve water and to ensure regular watering of all pertinent areas. The answer was in the Maxicom computer control system made by Rain Bird Sprinkler. Currently, five Huntsville parks are online with Maxicom. The city's plan is to have 12 parks (approximately 150 acres) irrigated within the next two years. The department is convinced that automatic irrigation was the right choice and that Maxicom and Maxi III are the right tools. (Main-PTT)
W88-03634

WATER LOSSES IN MEDEN AND TEBING TINGGI, INDONESIA,
Water Supply Co. for the Province of North-Holland, Assen (Netherlands).
For primary bibliographic entry see Field 5F.
W88-03680

FIELD STUDY INTO PATTERNS OF DOMESTIC WATER CONSUMPTION IN RURAL AREAS OF BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W88-03681

3E. Conservation In Industry

WATER CONSERVATION TECHNOLOGY IN TEXTILES: STATE OF THE ART.
Auburn Univ., AL. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-162400/AS. Price codes: A04 in paper copy, A01 in microfiche. WRRI Bulletin 46, May 1982. 62 p. David M. Hall, Warren S. Perkins, and James C. Warman, editors. Contract No. OWRT 14-34-0001-0506.

Descriptors: *Water conservation, *Wastewater treatment, *Water reuse, *Textile industry, *Conservation, *Dye industry wastes, Water use, Wastewater renovation, Ozonation, Chlorination, Ultrafiltration, Filtration, Membrane processes, Water treatment, Cooling water.

This monograph provides information on water, energy, and chemical conservation in textile manufacturing, concentrating on wet processing of textiles. Dyehouses currently use several techniques to conserve water and reduce pollutants in effluents: one-bath dyeing, caustic recovery in mercerizing and sanforizing, reuse of dye liquor cool back water, recycling of wash water, and recovery of indigo dye. Reduced wet pickup methods include the engraved roll pad, Triatex MA (electronic regulation of incoming and outgoing fabric weight to regulate the kiss roll), and vacuum extraction and recovery. Dye wastewaters can also be renovated for reuse with ozonation, chlorination, or ultrafiltration. The most efficient utilization of foam finishing resin occurs at about 30% wet pickup. Foam finishing processes substitute air for much of the water used in application of finishes and dyes. Water treatment for air conditioning systems and cooling towers is described. Water consumption in textile bleaching processes can be reduced by reducing the water flow rates and the number of water feeds and by prewashing with recycled water. The WECON systems uses a small heat pump to vaporize the waste stream and recover process water. Textile finishing plants can recycle water if the condition of the water is matched to the process. For example, bleach wastewater can be used in scouring. (Cassar-PTT)
W88-03495

UPGRADED WATER SYSTEM PROMISES INDUSTRIAL GROWTH,
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5F.
W88-03631

3F. Conservation In Agriculture

EFFECTS OF DROUGHT ON PRIMARY PHOTOSYNTHETIC PROCESSES OF COTTON LEAVES,
Paris-7 Univ. (France). Lab d'Ecologie Generale et Appliquee.
For primary bibliographic entry see Field 2I.
W88-03592

EFFECT OF AN INTERMITTENT WATER-TABLE GRADIENT ON SOIL AND XYLEM NITRATE IN COTTON,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
For primary bibliographic entry see Field 2I.
W88-03659

WATER FOR AGRICULTURE,
Agricor, Mafeking (South Africa).
For primary bibliographic entry see Field 6D.
W88-03678

INFLUENCE OF PRESTRESS ENVIRONMENT ON ANNUAL BLUEGRASS HEAT TOLERANCE,
Illinois Univ. at Urbana-Champaign. Dept. of Horticulture.
For primary bibliographic entry see Field 2I.
W88-03752

USE OF POLYVINYL CHLORIDE LINERS FOR LARGE IRRIGATION CANALS IN ALBERTA,
Alberta Environment, Edmonton.
For primary bibliographic entry see Field 4A.
W88-03755

CERES-MAIZE MODEL AS A POTENTIAL TOOL FOR DROUGHT ASSESSMENT IN SOUTH AFRICA,
Weather Bureau, Pretoria (South Africa).
For primary bibliographic entry see Field 6A.
W88-03770

IMPROVING TUBEWELL IRRIGATION SYSTEM PERFORMANCE,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
M. M. Miah, and R. W. Hill.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 303-316, August 1987. 3 fig, 4 tab, 9 ref.

Descriptors: *Tubewells, *Irrigation efficiency, *Irrigation, *Model studies, *Agriculture, Field tests, Pumps, Prediction, Water resources development.

Results of a field investigation on 10 selected deep tubewell irrigation systems in Bangladesh are presented. Development and application of a service area model to predict the impact of various improvement options are also discussed. The majority of the deep tubewells in the study are found to be severely underused in both the duration and efficiency of pump operation. The impact of each improvement alternative on service area expansion, as predicted by the model, varies among the tubewell systems. Increasing the pump operating hours is found to be the most effective measure for expanding the service areas of most study systems. Data used in the model application and economic analysis were obtained from field studies, technical papers, previous study reports, and judicious assumptions. Further verification of the model and updating of the conclusions may be needed. However, the model can be a useful tool in formulating successful service area development programs. (Author's abstract)
W88-03782

IRRIGATION EFFICIENCY: ECONOMIC INTERPRETATION,
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
For primary bibliographic entry see Field 6C.
W88-03783

ALGEBRAIC COMPUTATION OF FLOW IN FURROW IRRIGATION,
Universidade Federal do Ceara, Fortaleza (Brazil). Dept. of Agriculture Engineering.
S. L. A. Levien, and F. de Souza.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 367-377, August 1987. 4 fig, 13 ref.

Descriptors: *Model studies, *Irrigation design, *Algebraic equations, *Furrow irrigation, Mass conservation, Equations, Irrigation, Furrows, Simulation, Field tests, Models, Comparison studies.

A complete algebraic model simulating furrow irrigation is presented. It can be used to analyze and predict the performance of sloping open ended furrow irrigation systems, based upon the solution of a mass conservation equation. The model input variables are: length, slope, Manning roughness, infiltration parameters, furrow shape, inflow rate,

and cutoff time. All the information necessary to estimate the distribution of water and water-application efficiency for a particular irrigation event are obtained. Model performance is evaluated by comparison with field data and a more complex hydrodynamic model. Results show that the model gives reasonable results and, in most cases, more accurate results than more complicated models. (Author's abstract)
W88-03786

SURFACE-IRRIGATION NONLINEAR OPTIMIZATION MODELS,
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, and M. A. Marino.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 379-392, August 1987. 7 tab, 12 ref. ARS Cooperative Agreement 4350-H and CONICYT-Chile Project 060.

Descriptors: *Nonlinear models, *Irrigation models, *Model studies, *Irrigation design, *Irrigation management, *Optimization, Design criteria, Cost-benefit analysis, Costs, Benefits, Models.

Nonlinear optimization models are developed to design and manage furrow and border irrigation methods. The objective function of the basic nonlinear model is constructed on the basis of a profit relationship, while that of the expanded nonlinear model is constructed in terms of benefit and costs. The models are solved with the MINOS 5.0 package. The values of the design variables yielded by the nonlinear models are similar to those given by an existing linear optimization model. The expanded nonlinear model gives objective function (profit plus other costs) values that are greater than those of the basic nonlinear and linear models. (Author's abstract)
W88-03787

ALTERNATIVE METRIC UNITS FOR ACRE-FOOT AND ACRE-INCH,
Nebraska Wesleyan Univ., Lincoln.
For primary bibliographic entry see Field 7C.
W88-03788

RELATIONS BETWEEN REMOTELY SENSED CANOPY TEMPERATURE, CROP WATER STRESS, AIR VAPOR PRESSURE DEFICIT AND EVAPOTRANSPIRATION IN CHICKPEA,
Space Application Centre, Ahmedabad (India).
For primary bibliographic entry see Field 2D.
W88-03872

INTERACTIONS OF WATER VARIABLES AND GROWING DEGREE DAYS ON HEADING PHASE OF WINTER WHEAT,
Agricultural Research Service, Bushland, TX.
For primary bibliographic entry see Field 2I.
W88-03876

POTENTIAL GROUNDWATER IMPACTS FROM CHEMIGATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-03938

MORECS DISCUSSION MEETING: APRIL 1981.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W88-03952

MORECS: AN AGRICULTURAL PERSPECTIVE,
Nottingham Univ. (England). Dept. of Physiology and Environmental Science.
J. L. Monteith.
IN: The MORECS Discussion Meeting: April 1981, Institute of Hydrology, Wallingford, England. Report No. 78, August 1981. p 36-38, 1 fig, 4 ref.

Descriptors: *Models, *Agriculture, *Soil moisture deficiency, *Soil-water-plant relationships, *Irrigation requirements, Evaporation, Moisture deficiency, Transpiration, Rainfall, Agronomy, Model studies, Hydrologic models, Crop production, Irrigation programs, Soil water, Irrigation efficiency, Crop yield.

When using the Meteorological Office Rainfall and Evaporation Calculation Scheme (MORECS) for agriculture, growers want to know when to irrigate, how much water to apply and what increase of yield can be expected per unit of applied water. There is a range of soil water deficits (0 to D1) within which growth is restricted by environmental factors, such as light and temperature, rather than by water supply. Both transpiration and growth depend on the fraction of radiation intercepted by a canopy. This fraction is less when leaf expansion is restricted by drought. Stomatal closure in response to drought limits the diffusion of water vapor and carbon dioxide. The limiting deficit (D1) is determined by the maximum rooting depth of a crop, and by the available water/unit depth of soil in the root zone. The appropriate value of D1 for a specific crop in a specified soil will rarely be known to better than + or - 5 mm and will after be uncertain to + or - 10 mm. The timing of an irrigation will be determined by its place in a sequence of farming operations and may depart from the day on which D1 is achieved by say + or - 3 days, equivalent to + or - 10 mm of evaporation in a temperature climate. A farmer is unlikely to know how much water he has applied to better than + or - 5 mm. Agricultural meteorologists need more data from the field on appropriate values of D1 but hydrologists also need to know how surface resistance changes when D1 is exceeded. (Geiger-PTT)
W88-03958

CUMULATIVE MASS COORDINATE TO DETERMINE WATER PROFILE CHANGES IN VARIABLE VOLUME SOIL,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Soils
For primary bibliographic entry see Field 2G.
W88-04038

PHOSPHORUS FERTILIZER CARRIERS AND THEIR PLACEMENT FOR MINIMUM TILL CORN UNDER SPRINKLER IRRIGATION,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
W. R. Raun, D. H. Sander, and R. A. Olson.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 1055-1062, July-August 1987. 1 fig, 7 tab, 31 ref.

Descriptors: *Fertilizers, *Corn, *Phosphorus, *Sprinkler irrigation, Irrigation, Nitrogen, Ammonia, Tillage, Solute transport.

Several methods of placement and sources of P were evaluated for sprinkler irrigated corn (Zea mays L.) grown under minimum tillage on a Sharpsburg silty clay loam (Typic Argiudoll) and a Coly silt loam (Typic Ustorthent). Nitrogen and P, dual placed in a localized band (anhydrous ammonia applied with liquid P sources), accomplished greater P uptake and higher corn grain yields on a P deficient calcareous soil than P banded to the side of the seed or banded below the seed, although both methods increased early plant growth compared to either broadcast or P dual placed with NH3. Broadcast preplant applications of P were equally as effective as dual placed P in this study. Explanation of yield and P uptake enhancement by dual placement may lie in the synergistic effect of ammoniacal N and P placed together. The superior performance of the broadcast method of P application was apparently due to root activity near the surface of the soil or in the soil residue interface. Starter band applications gave higher yields than broadcast or dual placed methods of P application on a slightly acid medium P soil. The differences between the performance of the various methods of P application on these two soils, may be due to low subsoil P levels in the calcareous soil compared to the acid soil. Enhanced early P uptake with such row applications may increase yields where high subsurface P levels exist. Urea phosphate (UP) provided greater yields, grain P uptake, and total P uptake than ammonium polyphosphate (APP) and diammonium phosphate (DAP) at the calcareous site - especially when band (side), broadcast, and dual placement methods of P application were used. Total P concentration from plant tissue taken at the eight-leaf stage was greater for UP than APP and DAP on the slightly acid soil, but no yield differences could be attributed to sources at this site. (Lantz-PTT)
W88-04045

SOLUTE TRANSFER AND EXTRACTION FROM TRICKLE IRRIGATION SOURCE: THE EFFECTIVE HEMISPHERE MODEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Zemel, J. Ben-Asher, C. Charach, and M. Silberbush.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2091-2096, November 1987. 6 fig, 1 tab, 14 ref.

Descriptors: *Solute transport, *Trickle irrigation, *Saline soils, *Path of pollutants, Model studies, Ions, Water pollution sources,Mathematical analysis, Potassium, Nitrates, Crop uptake.

Solute distribution around a trickle source for three-dimensional steady state flow was studied in terms of an approximate analytic model, ion and water uptake by the root system into account. Moisture flow and ion concentration profiles are assumed to have hemispherical symmetry. The distributions are nearly constant near the source, with a sudden increase or decrease closer to the wetting front, depending on the ion balance. The competition between ion uptake and water extraction determines the nature of the concentration profile over the whole wet volume. Equations were derived that describe the situation where the two processes, i.e., ion uptake and water extraction, just compensate. These equations suggest a criterion for the highest allowed salinity. Higher values of discharge concentration at the source may result in intolerably high concentrations near the outermost wet region. The three-dimensional nature of the flow produces constant profiles over a large part of the wet region. The results of field measurements conducted on trickle-irrigated peanuts support these general conclusions. (Lantz-PTT)
W88-04186

MONITORING AND CONTROL OF CENTER PIVOT SYSTEMS WITH MICROCOMPUTERS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
D. M. Homan, M. D. Skold, and D. F. Heermann.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 903-909, October 1987. 6 fig, 2 tab, 12 ref.

Descriptors: *Groundwater management, *Irrigation practices, *Computers, *Center pivot irrigation, *Water conservation, Irrigation programs, Water-energy-management system, Irrigation efficiency, Irrigation, Economic aspects, Pumping costs, Monitoring, Model studies, Cost analysis.

A computerized water-energy-management system (WEMS) can be used by center pivot operators to reduce pumping fuel costs and monitoring expenses. Irrigation costs are lowered primarily because the system used climatic data and plant growth models to derive water schedules that considerably lower the use of water compared with conventional agricultural practices. A capital budget analysis of a hypothetical, but representative farm growing corn, shows that cost savings are from three sources: 61 percent from pumping less water, 28 percent from labor savings, and 11 percent from savings on truck fuel, maintenance, and oil. The analysis illustrates that only a 4 percent water savings from irrigation scheduling over a 10-year period is required for the investment to be profitable for many central High Plains' irrigators. The water savings required are relatively small compared with the potentials shown by irrigation scheduling research. WEMS is cost effective and can extend the life of the groundwater source. (Author's abstract)

W88-04294

WATER RESOURCES MANAGEMENT IN THE SEMI-ARID CENTRAL VALLEY OF CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 4B.
W88-04422

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD IN THE DESERT,
Eckhoff, Watson, Preator Engineering, Salt Lake City, UT.
For primary bibliographic entry see Field 2E.
W88-03604

USE OF POLYVINYL CHLORIDE LINERS FOR LARGE IRRIGATION CANALS IN ALBERTA,
Alberta Environment, Edmonton.
N.F. Weimer.
Canadian Geotechnical Journal CGLOAH, Vol. 24, No. 2, p 252-259, May 1987. 10 fig, 1 tab.

Descriptors: *Polyvinyl chloride, *Liners, *Design criteria, *Construction, *Canal seepage, Irrigation, Canals, Seepage, Monitoring, Alberta.

In 1982, the Government of Alberta began a program to rehabilitate and expand existing irrigation headworks systems within southern Alberta. Particular emphasis was placed on effectively minimizing future seepage from these canal systems. To fulfill this requirement, Alberta Environment undertook an extensive study of methods of seepage control that would be most appropriate for use in this program. The study concluded that the installation of a complete canal buried membrane lining was one of the most effective methods for controlling seepage. The geomembrane material selected for use as the buried liner for this installation was 0.5 mm (20 mil) thick polyvinyl chloride (PVC). The basis on which the complete canal buried membrane lining system was selected, the reasons for selecting the 0.5 mm (20 mil) thick PVC as the lining material, the quality control program for monitoring the purchasing of the PVC material, and the installation procedures used for placing the membrane within the canal cross section are presented. The design criteria and construction procedures relevant to the earth cover material being placed on the membrane liner are also presented. (Author's abstract)
W88-03755

FLOODS OF APRIL 1979, MISSISSIPPI, ALABAMA, GEORGIA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W88-03908

SEEPAGE STUDY OF SIX CANALS IN SALT LAKE COUNTY, UTAH, 1982-83,
Geological Survey, Salt Lake City, UT. Water Resources Div.
L. R. Herbert, R. W. Cruff, and K. M. Waddell.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Utah Department of Natural Resources, Salt Lake City, Technical Publication 82, 1985. 95 p, 18 fig, 7 tab, 1 ref.

Descriptors: *Utah, *Canal seepage, Canals, Water resources data, Water loss, Seepage studies, Salt Lake County.

A study of selected reaches of the Utah and Salt Lake, Utah Lake Distributing, Provo Reservoir, Draper Irrigation, East Jordan and Salt Lake City Canals in Salt Lake County, Utah, was made to determine gains or losses of flow in those reaches. Three to five sets of seepage measurements were made on each canal during 1982 or 1983. Adjustments for fluctuations in flow were made from information obtained from water-stage recorders operated at selected locations during the time of each seepage run. The study showed on overall net loss of about 9.5 cu ft/sec in the Utah and Salt Lake Canal, 11.0 cu ft/sec in the Utah Lake Distributing Canal, 20.5 cu ft/sec in the Provo Reservoir Canal, 1.5 cu ft/sec in the Draper Irrigation Canal, and 4.0 cu ft/sec in the East Jordan Canal. It also showed a net gain of about 6.0 cu ft/sec in the Jordan and Salt Lake City Canal. The gains and losses are attributed primarily to the relation of the canals to the depths of the water table near the canals. (USGS)
W88-03923

USE OF BIOLOGICAL CONTROLS FOR MANAGING GREAT LAKES DISTURBANCES,
State Univ. of New York Coll. at Oswego. Research Center.
R. W. Flint.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 93-95, 1987. 22 ref.

Descriptors: *Great Lakes, *Lake management, *Biological controls, *Biotechnology, Fish, Zooplankton, Management planning.

Nuisances in the Great Lakes environments (e.g., aquatic weeds, algae, sea lamprey) have most often been attacked through the use of chemicals or other unnatural means. Within the ecosystem approach to sound management of natural resources, convergent strategies must be developed that do not achieve short term economic goals at the expense of the environment. With increased awareness in biotechnology, attention should be paid to adapting biological characteristics of Great Lakes ecosystems that will contribute to control of nuisances. Biological control, an extension of biotechnology, is largely based upon processes that occur naturally in the environment. The most recent example in the aquatic environment is the manipulation of trophic levels to control or eliminate nuisance populations. Fish and zooplankton have been manipulated to control phytoplankton. Salmonid stocking programs in some of the Great Lakes were, among other reasons, initiated to control the abundant alewife populations and reduce massive annual die-offs. The benefits of biological control methodologies should be obvious. Difference in resources expended (i.e., time and money) for reliance on unnatural control mechanisms (e.g., chemical treatment) versus tapping natural environmental characteristics could be sizeable. The development of biological control technology would significantly benefit user groups by providing alternative solutions to nuisance problems that emphasize sustainability of the natural environment and may minimize future ecosystem surprises. (Lantz-PTT)
W88-04213

DESIGN OF STORMWATER DETENTION BASINS FOR MULTIPLE DESIGN FREQUENCIES,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
L. E. Ormsbee, J. W. Delleur, and M. H. Houck.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 601-614, May 1987. 7 fig, 7 tab, 14 ref, append. Office of Water Research and Technology Project No. OWRT-14-34-1110-0498.

Descriptors: *Urban runoff, *Simulation analysis, *Stormwater, *Detention dams, *Design standards, Hydraulic structures, Statistical analysis, Water management.

A general planning methodology has been developed for use in the planning of dual-purpose detention basins. The methodology employs continuous simulation, statistical analysis, and a general design heuristic to obtain an integrated system of detention basins. Both water quality and water quantity constraints may be considered. The methodology developed is used to examine two potential strategies for the design of stormwater management facilities for multiple design frequencies; the regressive design strategy and the sequential strategy. These two strategies were applied to a synthetic water shed constructed from average geomorphic parameters for the state of Indiana. The synthetic watershed was analyzed for both undeveloped and developed conditions using 20 yrs. of hydrologic data and different design events constructed for 5-, 10-, and 20-yr design frequencies. Neither strategy can always be quaranteed to be better. The regressive design strategy should always produce the least expensive design; the sequential strategy will generally always produce a feasible design. (Lantz-PTT)
W88-04268

FREE-SURFACE SWIRLING FLOWS IN VERTICAL DROPSHAFT,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8B.
W88-04464

CHARACTERISTICS OF SESTON IN A REGULATED APPALACHIAN MOUNTAIN RIVER, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-04473

RIVER REGULATION IN SPAIN,
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Montes.
For primary bibliographic entry see Field 2E.
W88-04477

4B. Groundwater Management

WIRELINE PISTON CORE BARREL FOR SAMPLING COHESIONLESS SAND AND GRAVEL BELOW THE WATER TABLE,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 7B.
W88-03758

PRELIMINARY MODELING OF A DOUBLET-WELL SYSTEM FOR AQUIFER THERMAL-ENERGY STORAGE,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03885

OPTIMAL CONTROL OF NONLINEAR GROUNDWATER HYDRAULICS USING DIFFERENTIAL DYNAMIC PROGRAMMING,
California Univ., Los Angeles. Dept. of Civil Engineering.
L. Jones, R. Willis, and W. W. G. Yeh.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2097-2106, November 1987. 5 fig, 5 tab, 23 ref. NSF Grant No. CEE83-01230.

Descriptors: *Groundwater management, *Computer programs, *Computer models, *Model studies, Mathematical studies, Artificial recharge, Groundwater mining, Groundwater recharge, Aquifers, Hydraulic properties.

Optimal groundwater management models are based on the hydraulic equations of the aquifer system. These equations relate the state variables of the groundwater system, the head, and the decision variables that control the magnitude, location, and timing of pumping, or artificial recharge. A differential dynamic programming (DDP) algorithm is used for unsteady, nonlinear, groundwater management programs. Due to the stagewise decomposition of DDP, the dimensionality problems associated with embedding the hydraulic equations as constraints in the management model are significantly reduce. In addition, DDP shows a linear growth in computing effort with respect to the

number of stages or planning periods, and quadratic convergence. Several example problems illustrate the application of DDP to the optimal control of nonlinear groundwater hydraulics. (Author's abstract)
W88-04187

ECOLOGICAL EFFECTS OF GROUNDWATER PUMPING AND A NATURAL DROUGHT ON THE UPPER REACHES OF A CHALK STREAM,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 6G.
W88-04228

MICROCOMPUTER-BASED INTERACTIVE AQUIFER SIMULATOR,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
T. H. Illangasekare, and J. H. Brannon.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 573-582, May 1987. 3 fig, 19 ref, append.

Descriptors: *Simulation analysis, *Aquifers, *Computer models, *Drawdown, *Groundwater management, *Microcomputers, Groundwater mining, Model studies, Hydrologic models.

Decisions on the timing and location of pumping or recharge in aquifers are in general subjected to physical and operational constraints. The physical constraints are determined by the hydrologic behavior, and the operational constraints by the rules of operation of water allocation and use. The determination of the best strategy of operation requires the simulation of both the physical and operational behavior. In a model designed for interactive decision making, the user can interact with the simulator using a video terminal that graphically displays the simulated state of the system. In an interactive simulation model based on the 'Discrete Kernel Approach' the response functions due to unit pulse excitations are generated using a mainframe computer. After these response functions are generated and stored, the simulation reduces to a simple discrete convolution. These relatively efficient simple computations are done on a microcomputer. Color computer graphics are used to project the simulated state. (Author's abstract)
W88-04266

INTERSTATE AND INTERNATIONAL COMPETITION FOR WATER RESOURCES,
Hawaii Univ. at Hilo. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W88-04290

MONITORING AND CONTROL OF CENTER PIVOT SYSTEMS WITH MICROCOMPUTERS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W88-04294

WATER RESOURCES MANAGEMENT IN THE SEMI-ARID CENTRAL VALLEY OF CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
J. J. Vasconcelos.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 97-106, 4 fig, 14 ref.

Descriptors: *Water quality control, *Water resource development, *Resource management, *Semiarid lands, *California, *Groundwater management, Mathematical models, Water quality management, Groundwater recharge, Management planning, Computer models, Groundwater pollution, Selenium, Solute transport, Agriculture, Model studies.

Applications of groundwater resource management models in the semiarid Central Valley of California are presented. In recent years, high concentrations of selenium have been appearing in drainage from newly irrigated lands, focusing public attention on water resource mangement problems of the region. To solve problems of groundwater overdraft and saline water intrusion, the San Luis Drain was built to transport mineralized agricultural drainage waters from the west side of the San Joaquin Valley to the western part of the Sacramento-San Joaqin River Delta for eventual discharge to Kesterson Reservoir. Water quality studies showed high levels of selenium in wildfowl at Kesterson National Wildlife Refuge. A finite difference groundwater solute transport model was developed to investigate the long term effects of a number of wastewater disposal and groundwater recharge alternatives for the groundwater basin. The U. S. Geological Survey developed three interrelated three-dimensional groundwater models of the Central Valley aquifer system. The San Joaquin Valley Hydrologic-Economic Model analyzes the economics of both agricultural production and water resource management in developing long range planning and policy alternatives for surface and groundwater resources of the San Joaquin Valley. The Fresno water resources quality management model can be used as a regional water resources management model. It features a groundwater solute transport computer model. The Fresno model was used to evaluate four hypothetical long term water resource management alternatives for the groundwater sub-basin underlying Central Fresno County. (Geiger-PTT)
W88-04422

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF LAND USE HISTORY ON SEDIMENTATION IN THE POTOMAC ESTUARY, MARYLAND,
Geological Survey, Lakewood, CO. Water Resources Div.
R. S. DeFries.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2234-K, 1986. 23 p, 26 ill, 4 tab, 48 ref.

Descriptors: *Estuaries, *Pollen, *Sedimentation, *Sediment distribution, *Palynology, *Potomac Estuary, Sediments, Bottom sediments, Sediment transport, Vegetation, Maryland, Virginia, Land use.

Pollen assemblages preserved in 20 sediment cores collected throughout the Potomac Estuary record the land-use history of the lower Potomac drainage basin. A slight increase in the proportion of ragweed, an agricultural weed, dates the 1634 initial European settlement, and a large increase in the proportion of ragweed dates extensive land clearance accompanying the 1840 agricultural revival. The presence of water-chestnut seeds indicates the water-chestnut infestation around 1930. Dated horizons in the cores are used to calculate sedimentation rates and sediment fluxes, which vary from 0.21 to 1.72 centimeters/yr, and from 0.09 to 1.14 grams/centimeter sq/yr. Fairly constant pollen concentrations with depth indicate that European settlement did not affect sedimentation rates in the mouth of the estuary, and that intensive construction activities, beginning in the 1950's, also did not affect sedimentation rates throughout much of the estuary. The effects of human activity in the drainage basin on sedimentation apparently are confined to local areas. Areal distribution of a local pollen type in five cores from the Port Tobacco subestuary indicates that about 75% of the fine-grained sediments entering the head of the subestuary is deposited in the upper one-third of the subestuary and little is transported to the Potomac Estuary. The subestuaries thus are depositional areas for sediment associated with accelerated erosion from land use in the drainage basin. Sedimentation rates generally are slow in the lower reach of the Potomac Estuary and rapid in the freshwater upper reach, as well as in the middle estuary around Kettle Bottom Shoals. Circulation patterns, changes in competence in the estuary, shore erosion, or landward transport of sediment from the Chesapeake Bay may be more important controls on sedimentation patterns in the estuary than land use in the drainage basin. (USGS)
W88-03901

HYDROLOGIC MODELS OF SURFACE MINED AREAS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 7A.
W88-03941

WATER QUALITY AND DIATOM COMMUNITIES IN TWO CATALAN RIVERS (N.E. SPAIN),
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5C.
W88-04252

PRELIMINARY STUDY OF THE EFFECTS OF DRAINAGE AND HARVESTING ON WATER QUALITY IN OMBROTROPHIC BOGS NEAR SEPT-ILES, QUEBEC,
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 785-791, October 1987. 2 fig, 1 tab, 28 ref.

Descriptors: *Ecological effects, *Peat bogs, *Drainage effects, *Peat harvesting effects, *Water quality, Ombrotrophic bogs, Runoff, Groundwater, Quebec, Bogs, Specific conductance, Organic carbon, Comparison studies, Wetlands, Humic acids, Nutrients, Phosphorus, Potassium, Sodium, Ammonium, Nitrogen.

Runoff and groundwater samples were collected from four ombrotrophic bogs, representing undisturbed and drained/harvested conditions, at two-week intervals during the summer of 1984. Analyses of samples for water quality parameters, revealed significant ($P < 0.05$ level) increases in specific conductance, NH4(+)-N, total dissolved P, Mg, K, and Na and a decrease in the E4:E6 ratio (suggesting increased proportions of humic acid) associated with drainage. There were no significant changes in dissolved organic carbon, Ca concentrations, or pH. Comparisons of samples collected before, during, and after ditching showed increases in the dissolved organic carbon, NH4(+)-N, total dissolved P, K, and Na and a decrease in the E4:E6 ratio, but these changes were short-lived; water quality returned to pre-ditching values after about a week. The observed changes in water quality are small, probably because the peat is very acidic (pH 3.0 to 4.5). (Author's abstract)
W88-04278

FECAL COLIFORM CONCENTRATIONS IN RUNOFF FROM A GRAZED, RECLAIMED SURFACE MINE,
Agricultural Research Service, Beckley, WV. Appalachian Soil and Water Conservation Research Lab.
For primary bibliographic entry see Field 5B.
W88-04295

4D. Watershed Protection

STEEP SLOPE SEWER CONSTRUCTION CRITERIA,
For primary bibliographic entry see Field 8A.
W88-03599

PROTECTION OF BANKS AND ROADBEDS FROM EROSION ON RIVER 'NIPS',
V. G. Salikov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 575-580, April 1987. 2 fig, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 18-21, October 1986.

Descriptors: *Erosion control, *Bank protection, *Bank stabilization, *Rivers, *Roadbeds, *Designs, *Soviet Union, *Riprap, Foreign research, Groins,

Concave banks, Soil stability, Hydrodynamics, Current velocity, Channels, Spur dikes, Floods, Currents, Planning, Flow.

An effective and widespread method of protecting concave banks of meandering rivers from erosion is protection of their slopes with riprap and the use in certain cases of spur dikes. The stability of slope protection on the main channel, roadbed, or groin is determined by the hydrodynamic effect of the flow which depends mainly on the current velocity at the concave bank. Optimal stone size for the protective layer on the slopes can be arrived at through the following determinations: average velocity of channel flow on the stretch of nip at various sites along the length of the meander; average velocity and foot of the slope of the nip bank at each site; and existing protective layer stone size along various stretches of the meander. Recommendations developed make it possible to determine the stone size in the protective layer of bank slopes and groins; to determine the location and angle of groin bends and distance between groins; to distinguish the groin head region most subject to hydrodynamic effects of the flow; and to calculate protection of the groin heads and bank slopes in the intergroin space. (Main-PTT)
W88-03620

MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN PAKISTAN,
Pakistan Forest Inst., Peshawar.
For primary bibliographic entry see Field 2J.
W88-03636

MATHEMATICAL MODEL FOR EVALUATION OF THE EFFECT OF SOIL EROSION ON SOIL PRODUCTIVITY,
Kentucky Univ., Lexington. Dept. of Statistics.
For primary bibliographic entry see Field 2J.
W88-04243

UPLAND SOIL EROSION SIMULATION FOR AGRICULTURAL WATERSHEDS,
Auburn Univ., AL. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W88-04282

SOIL CONSERVATION PRACTICES AND WATER QUALITY: IS EROSION CONTROL THE ANSWER,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
B. M. Crowder, and C. E. Young.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 897-902, October 1987. 2 tab, 19 ref.

Descriptors: *Soil conservation, *Erosion control, *Water quality control, Water quality, Simulation analysis, Model studies, Agricultural runoff, Economic aspects, Water pollution sources, Crop production, Agriculture, Costs, Cost analysis, Computer models, CREAMS.

A computer simulation analysis of an agricultural nonpoint pollution problem is proposed for establishing the linkages between and the quality of agricultural runoff in both surface and subsurface flow. The tradeoffs between the costs of soil conservation practices and water quality are reported, and the economic implications of such tradeoffs are discussed. Soil and nutrient losses resulting from crop production practices are analyzed using a field-scale computer simulation model (CREAMS). No-till planting, reduced tillage, and sod waterway systems are more cost effective than other practices for controlling soil and nutrient runoff losses. Nitrate leaching losses are increased slightly by most soil conservation practices. Terrace systems and permanent vegetative cover impose the greatest societal cost for water quality protection. Public cost sharing and tax incentives encourage farmers to adopt expensive structural practices, and policies are needed to get cost-effective practices implemented on critical acreage. Extensive treatment of land is necessary for agricultural best management practices to significantly improve water quality in areas that are intensively farmed. (Author's abstract)
W88-04293

STABILITY OF ROCK PROTECTION ON SLOPES,
T. Ulrich.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 7, p 879-891, July 1987. 7 fig, 3 tab, 6 ref, 4 append.

Descriptors: *Bank protection, *Bank stability, *Slope stability, Hydraulic characteristics, Flow pattern, Mathematical analysis.

The stability of rock protection on slopes attacked by a flow requires two conditions. The first is the resistance to sliding that is provided if the ratio of tangential forces to normal forces on one or several rock layers is less than the tangent of the angle of friction of the layers on their support. The second is the resistance to wrenching of the surface layer blocks and is covered by equations derived from the Shields criteria. A new approach is proposed to two factors in the analysis, namely: (1) For downslope flow the hydrostatic pressure gradient is not vertical but normal to the slope, and thus existing equations expressing the effect of slope on the threshold shear stress are modified; and (2) a condition of stability that involves the bearing angle of a surface-layer block thrusting on neighboring stable blocks that is wider than the commonly used angle of repose. (Author's abstract)
W88-04389

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

USE OF THE FLUCTUATION TEST TO DETECT MUTAGENIC ACTIVITY IN UNCONCENTRATED SAMPLES OF DRINKING WATERS IN THE UNITED KINGDOM,
Water Research Centre, Marlow (England).
R. Forster, M. H. Green, R. D. Gwilliam, A. Priestley, and B. A. Bridges.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1189-1197, 4 tab, 9 ref.

Descriptors: *Pollutant identification, *Water pollution effects, *Mutagens, *Water analysis, Bacteria, Fluctuation test, Drinking water.

Determination of mutagenicity in unconcentrated drinking water samples using the fluctuation test is complicated by an artifact. This liquid-medium-based test uses Salmonella tester strains. In most cases apparently positive results can be attributed to differences in the histidine-limited yield of bacteria in the test. In those cases where the results are only partly explained by this effect, it would be difficult to state with confidence that the substances are mutagenic. To be effective, bacterial titer is necessary. This step detracts from the simplicity of the fluctuation test. (Cassar-PTT)
W88-03536

MUTAGENIC SUBFRACTIONS FROM NON-VOLATILE ORGANICS OF DRINKING WATER,
Cincinnati Univ., OH. Coll. of Medicine.
J. C. Loper, M. W. Tabor, and S. K. Miles.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1199-1210, 9 fig, 1 tab, 16 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Mutagens, Resins, Ion exchange.

Organic compounds, concentrated on XAD resins as complex residue mixtures, were separated by high performance liquid chromotography and subjected to the Ames test for mutagenicity. No mutagenic artifacts from the interaction of the resin with chlorinated water were apparent. Mutagenic residues were collected from drinking water samples from two cities with different surface water sources. The apparent mutagenic activity per liter equivalent dose, concentrated in fractions of intermediate polarity, varied by about threefold among samples. (Cassar-PTT)
W88-03537

HEALTH EFFECTS OF WATER REUSE: CHARACTERIZATION OF MUTAGENIC RESIDUES ISOLATED FROM RECLAIMED, SURFACE, AND GROUNDWATER SUPPLIES,
Los Angeles County Sanitation Districts, Whittier, CA.
C. A. Jacks, J. P. Gute, L. B. Neisess, R. J. Van Sluis, and R. B. Baird.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1237-1248, 1 fig, 5 tab, 16 ref.

Descriptors: *Pollutant identification, *Water pollution sources, *Mutagens, *Organic compounds, *Chlorination, Reclaimed water, Wells, Groundwater, Surface water, Water supply, Water treatment, Water reuse.

Mutagenic activity was detected in 84% of water samples, showing direct-acting mutation on TA98 and TA100. Addition of S9 decreased activity on both strains for all sample types and resulted in complete deactivation of TA100 mutagens for imported Colorado River water and storm runoff. Chlorinated wells were positive on both strains 90% of the time, whereas 70% of the unchlorinated wells were positive. Imported water samples were active on both strains 33% of the time, whereas 67% of the storm waters were positive. Reclaimed waters were positive on both strains 38% of the time (chlorinated, 44%; dechlorinated, 50%; unchlorinated, 0%). Although chlorination of reclaimed or well water did not appreciably increase potency, the incidence of TA100 activity was more consistent for chlorinated samples. In general, reclaimed water and storm runoff contained the highest levels of mutagenicity. Most of the mutagenic activity was found in the nonpolar fractions from a reverse-phase gradient. Size exclusion chromatography fractions showed no activity in molecular weight fractions above 800. Unchlorinated well water partitioned in 72 fractions by reverse-phase showed no mutagenicity in any fraction; however, total residues and recombined fractions had activities of 200 and 170 revertants/L, respectively. Acid and base fractions of the reclaimed water showed no activity at the 280 revertants/L detection level; total and neutral residues had activities of 4900 and 2000 revertants/L, respectively. Preliminary results of reaction of total residues with silver nitrate and 4-nitrpthiophenol are reported. (Cassar-PTT)
W88-03540

CONTRIBUTIONS OF SOME CHLORINATED ALIPHATIC COMPOUNDS TO THE MUTAGENICITY OF SPENT KRAFT PULP CHLORINATION LIQUORS,
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5B.
W88-03544

EVALUATION OF THE SANITARY QUALITY OF MARINE RECREATIONAL WATERS AND SANDS FROM BEACHES OF THE SAO PAULO STATE, BRAZIL,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
P. S. Sanchez, E. G. Agudo, F. G. Castro, M. N. Alves, and M. T. Martins.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 61-72, 1986. 3 fig, 5 tab, 36 ref.

Descriptors: *Pollutant identification, *Water quality, *Public health, *Microorganisms, Bacteria, Enteroviruses, Parasites, Pathogenic bacteria, Pathogenic fungi, Viruses.

A 19 month study (1984-1985) was undertaken at 9 sampling stations to evaluate the sanitary quality of marine recreational waters and sand at some beaches of Sao Paulo State, Brazil. A total of 342 samples of sea water and sand were analysed for total and fecal coliforms, fecal streptococci, Pseudomonas aeruginosa, and Salmonella. Sand samples were examined for Candida albicans, dermatophytes, Pityrosporum, helminth eggs, and protozoan cysts. Sea water samples were also analysed for enteroviruses and enterococci. Some areas exhibited high levels of fecal contamination of sea water and sand. The recommended limits (fecal coliforms 1000/100ml, total coliforms 5000/100ml) were exceeded in 31% of sea water samples. Salmonella was detected in 10.5%, and enteroviruses in 3.5%, of the 171 sea water samples analysed. Candida albicans was found in 18.7%, and helminth eggs in 12.9%, of the 171 sand samples; Pityrosporum, dermatophytes, and protozoan cysts were not detected. (Authors' abstract)
W88-03566

SOME LIMITS IN CURRENT ADSORPTION-ELUTION METHODS FOR THE DETECTION OF VIRUSES IN LARGE VOLUMES OF TAP WATER,
Centre de Recherche de Maisons-Laffitte (France).
J. C. Joret, A. Hassen, P. Hartemann, and J. M. Foliguet.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 133-140, 1986. 2 fig, 3 tab, 17 ref.

Descriptors: *Viruses, *Pollutant identification, *Analytical methods, *Waste analysis, *Water treatment, *Microbiological studies, Water analysis, Viruses, Enteroviruses, Filtration.

Virus concentration by adsorption to, and elution from, electronegative microporous filters is nowadays the most commonly used method for detecting viruses in the field. However, the need for constant addition of HCl and salts and the drastic conditions of pH during the adsorption step constitute some of the limitations of this flow-through method. A promising method for concentrating viruses from tap water at ambient pH levels without addition of cations is the use of electropositive microporous filters. This study compared two types of electropositive filters for Poliovirus 1, Coxsackie virus B3, Coxsackie virus A9 and E.C.H.O. virus 1 recovery from tap water with different pH levels. For small volumes of tap water sampled, both adsorbents gave equally satisfactory recoveries of Poliovirus 1 (46-82%) at pH 6.7, 7.9, or 9. However, elution percentages using 3% beef-extract solution pH 9.5 were generally better for 1 MDS than for AS filters. As the volume of tap water sampled increased, increasing amounts of Poliovirus were unadsorbed onto both types of filters at pH 7, 7.9, or 9. Lowering the pH to 6 gave better Poliovirus 1 and Coxsackie B3 recoveries with AS (61% and 95%, respectively) and 1 MDS filters (67% and 91%, respectively). E.C.H.O. virus 1 recovery was not affected by acidification and was lower with MDS (6%) than with AS filters (37%). Coxsackie virus A9 recovery was very low for both filters (<11%). As for electronegative adsorbents, currently available methods for concentrating viruses using electropositive filters have to be optimized to recover most enteric viruses occurring in waters. (Authors' abstract)
W88-03574

VIRUS ADSORPTION TO MICROPOROUS FILTERS MODIFIED BY IN SITU PRECIPITATION OF METALLIC SALTS,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
G. A. Toranzos, G. W. Erdos, and S. R. Farrah.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 141-148, 1986. 2 fig, 5 tab, 13 ref.

Descriptors: *Water analysis, *Water treatment, *Analytical methods, *Microbiological studies, *Viruses, Public health, Microorganisms, Bacteriophages, Biological filters, Biofilters.

The detection of enteric viruses and studies on the ecology of bacteriophages frequently employ procedures to detect relatively small numbers of viruses in water. Membrane filters have been used to filter large volumes of water, followed by elution to recover the viruses. Both negatively and positively charged filters have been used. In general, negatively charged filters are less expensive but require that water samples be adjusted to pH 3.5 or treated with salts. This study determined the ability of microporous and depth filters modified by in situ precipitation of different metallic salts to adsorb viruses at neutral pH. Microporous and depth filters composed of fiberglass, cellulose, and nitrocellulose were placed in solutions of soluble metallic salts such as ferric chloride. Following adsorption of the soluble salt, filters were allowed to dry and were then placed in a solution of sodium or ammonium hydroxide, forming stable precipitates in and around the filter fibers. Modified filters adsorbed significantly more viruses than unmodified filters. Filters modified with combinations of salts, such as ferric and aluminum or magnesium, generally were better virus adsorbers than filters modified by the precipitation of a single salt. (Authors' abstract)
W88-03575

STUDIES OF PROCEDURES FOR RECOVERY OF VIRUSES FROM ACTIVATED SLUDGE,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
E. Shimohara, M. Nashida, and M. Kaneko.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 149-156, 1986. 8 tab, 6 ref.

Descriptors: *Analytical methods, *Sludge, *Wastewater treatment, *Viruses, Enteroviruses, Microorgansims, Public health, Microbiological studies.

Several elution media were examined to evaluate their suitability for recovering seeded poliovirus 1 from return activated sludge. Although there were no distinct differences of virus recovery efficiency among the media tested, 3% beef extract solution at pH 9 seemed to be the most practical eluent for the recovery of viruses adsorbed from the sludge with an average recovery efficiency of 21% (range, 6.1-34%). The organic flocculation procedure using beef extract was applied to concentrate the eluted viruses. Its effect depended upon the type of eluate, and viruses were not always concentrated well. (Authors' abstract)
W88-03576

INDICATOR SYSTEMS FOR ASSESSMENT OF THE VIROLOGICAL SAFETY OF TREATED DRINKING WATER,
National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 159-165, 1986. 2 tab, 18 ref.

Descriptors: *Analytical methods, *Water analysis, *Water treatment, *Viruses, Enteroviruses, Bacteria, Pathogenic bacteria, Coliforms, Bacteriophages, Public health.

Conventional methods cannot detect the viruses of prime importance, and are too expensive, complex and slow for routine quality surveillance. Coliform bacteria generally used as indicators of virological quality also may have shortcomings because viruses have been recovered from drinking waters which meet conventional coliform limits, and some viruses may be more resistant to certain disinfection conditions. The shortcomings of coliforms can be overcome, however, by inclusion of additional indicator organisms. Indicator systems consisting of various combinations of standard plate counts, coliphages, fecal streptococci, Pseudomonas aeruginosa, acid-fast bacteria and clostridia proved reliable and practical for surveillance of the virological safety of drinking water supplies, even those derived from the direct reclamation of wastewater. The combination of indicator systems depends on factors such as the quality of the raw water, the treatment processes, and the efficiency of operation. Despite practical and reliable features of available indicator systems, further refinement is essential. This should include analyses at higher frequency and results in less time, ideally in the form of continuous early-warning alarm systems. Equally important is technology which is within reach of the limited financial resources and expertise of those parts of the world which suffer most from waterborne diseases. (Author's abstract)
W88-03577

EVALUATION OF BACTEROIDES FRAGILIS BACTERIOPHAGES AS INDICATORS OF THE VIROLOGICAL QUALITY OF WATER,
Barcelona Univ. (Spain). Dept. of Microbiology.
J. Jofre, A. Bosch, F. Lucena, R. Girones, and C. Tartera.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 167-173, 1986. 2 fig, 2 tab, 21 ref.

Descriptors: *Analytical methods, *Water analysis, *Bacteriophages, *Viruses, *Bioindicators, Public health, Indicators, Microorganisms.

The survival and transmission of viruses in sewage contaminated water is a potential public health problem. Practical methods for the detection of viruses of concern are not always available, and techniques for both the recovery and identification of human enteric viruses have limited sensitivity, are time consuming and expensive, and require highly skilled labor and sophisticated laboratory facilities. One concern is the adequacy of indicator bacteria for predicting the virological quality of water, and indicators closely related to enteric viruses should be preferred. Bacteriophages may play a valuable role in this regard because their structure, composition, morphology and size closely resemble that of enteric viruses. Coliphages have been proposed as viral indicators but they have several shortcomings. Bacteriophages infecting Bacteroides fragilis 40 were found in all kinds of sewage polluted samples. but were never recovered either in non-fecally polluted samples or in samples only polluted by wildlife. In simulated laboratory experiments, a selected bacteriophage, B40-8, active against B. fragilis 40, did not replicate either in aerobiosis or under anaerobic conditions when the culture medium was substituted by either fresh water, seawater or sediments. Inactivation rates of the same bacteriophage were studied in comparison with other viruses, such as poliovirus 1, simian rotavirus SA11 and f2 coliphage, showing decay rates similar to or inferior to those of the other viruses studied. The results from this study indicate that bacteriophages infecting B. fragilis may be good candidates for a surrugate indicator of human viruses in the environment. (Authors' abstract)
W88-03578

MICROBIAL INDICATORS FOR THE EFFICIENCY OF DISINFECTION PROCESSES,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
K. Kawamura, M. Kaneko, T. Hirata, and K. Taguchi.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 175-184, 1986, 10 fig, 1 tab, 3 ref.

Descriptors: *Wastewater treatment, *Water analysis, *Analytical methods, *Water treatment, *Disinfection, *Bioindicators, Indicators, Bacteria, Viruses, Public health, Ultraviolet radiation.

Fundamental studies were conducted to find new microbial indicators for the effective inactivation of microorganisms resistant to disinfectants and UV radiation. Escherichia coli, Salmonella typhimurium, Staphylococcus aureus, Candida tropicalis and spore-forming bacteria (isolated from sewage) were exposed to free chlorine or free ozone at concentrations of 0.01-1.0 mg/liter, and 253.7 nm UV at light intensity levels of 10-1000 microW/sq cm. For all disinfectants examined a relationship between disinfectant concentration and contact time for 99% reduction of microorganisms was found to be valid. The order of resistance was spore-forming bacteria >> C. tropicalis >> Staph. aureus, E. coli, and S. typhimurium. However, at the same disinfectant concentration, the contact time required to obtain the same inactivation efficiency was reduced effectively by

ozone. UV light inactivates spore-forming bacteria and C. tropicalis more effectively than chlorine, although the intensity of UV light and the concentration of chlorine studied have similar effects on E. coli. Spore-forming bacteria may be the ideal microorganisms to evaluate the completeness of disinfection, but they require a long contact time to be inactivated by chlorination. However, when ozone or UV irradiation is used as the method of disinfection, spore-forming bacteria can be used as an indicator, because they are then inactivated under usual field conditions in contact or irradiation time. (Authors' abstract)
W88-03579

DETECTION OF CRYPTOSPORIDIUM FROM WASTEWATER AND FRESHWATER ENVIRONMENTS,
Arizona Univ., Tucson. Dept. of Microbiology.
J. B. Rose, A. Cifrino, M. S. Madore, C. P. Gerba, and C. R. Sterling.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 233-239, 1986. 4 tab, 22 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Cryptosporidium, *Parasite, *Human diseases, Protozoan, Diseases, Pathogens *Microorganisms.

Cryptosporidium is a coccidian protozoan recently recognized as a cause of human gastroenteritis. The illness may be severe in immuno-compromised individuals and can result in death. The organism is monoxenous, and infective oocysts are shed in the feces, which are transmitted via the fecal-oral route. Therefore, Cryptosporidium is a candidate as an etiological agent of waterborne or foodborne disease. Lack of detection methods for this organism in diarrheal samples and environmental samples has made it difficult to substantiate this premise. Cryptosporidium oocysts in water can now be detected using a filtration-elution procedure. A fluorescently-labelled monoclonal antibody has been used to detect Cryptosporidium in feces and environmental samples. The method uses (1) filtration with polypropylene cartridge filters, (2) elution with Tween 80/detergent, (3) concentration with Sheather's flotation, and (4) detection on membrane filters. Recovery from the sucrose gradient step averaged 72-82%. Overall recovery efficiencies averaged 50% (range 25-82%), but were diminished with low seeds. Concentrations ranged from 60 to 52,000 oocysts per gallon of treated and raw sewage. In fresh water, oocysts numbered 8 to 22,000 per gallon, and were concentrated in rapid sand filters averaging 59,000 per gallon in the backflush. Cryptosporidium may now be considered a potential waterborne disease. (Authors' abstract)
W88-03586

FLUORESCENCE DETERMINATION OF TRACE AMOUNTS OF URANIUM(VI) IN VARIOUS MATERIALS BY A REPETITIVE LASER TECHNIQUE,
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
G. I. Romanovskaya, V. I. Pogonin, and A. K. Chibisov.
Talanta TLNTA2, Vol. 34, No. 1, p 207-210, January 1987. 3 fig, 4 tab, 14 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Water analysis, *Lasers, *Uranium, *Spectral analysis, *Natural waters, *Fluorescence, Nitrogen, Wavelengths, Cells, Photons, Trace levels, Detection limits, Emission spectroscopy, Radiation.

A laser-induced fluorescence method (LFM) is described for determination of trace amounts of uranium(VI), with a detection limit of 4 x 10 to the minus 11th power g/ml. A repetitive pulsed laser, time discrimination and an averaging technique were used. The optimum time discrimination was obtained when the uranium ion was complexed with phosphoric acid or sodium polysilicate. LFM did not need a preconcentration step or separation of uranium from interfering elements. The time needed for analysis was 1-2 minutes. (Author's abstract)
W88-03611

STUDY OF COPPER (II) COMPLEX COMPOUNDS WITH BISMUTHIOL DERIVATIVES IN BUTANONE,
Moscow State Univ. (USSR).
L. N. Simonova, and M. Granda.
Analytical Letters ANALBP, Vol. 20,No. 4, p 537-552, 1987. 2 fig, 3 tab, 12 ref.

Descriptors: *Analytical methods, *Complexes, *Measuring instruments, *Copper, *Natural waters, *Water analysis, *Chemical analysis, Tap water analysis, Copper, Methyl ethyl ketone, Butanone, Benzyl bismuthiol.

The formation and extraction of copper (II) in the form of benzyl bismuthiol and naphthyl bismuthiol chelates was studied. The reagents' solvation in butane was investigated and optimum conditions for extraction were established. Both chelates have been studied in solution and in solid form. After studying the influence of 14 possible interferences, an atomic absorption spectrometric determination of copper using both reagents was carried was carried out in tap water samples. (Author's abstract)
W88-03638

NIWR INTERLABORATORY COMPARISON STUDY NO. 81/A: NITROGEN AND PHOSPHOROUS ANALYSIS, EVALUATION OF RESULTS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith.
Research Report No. 398, 1981. 29 p, 6 fig, 11 tab, 17 ref, 2 append.

Descriptors: *Pollutant identification, *Water analysis, South Africa, Nitrogen, Nitrates, Nitrites, Ammonia, Phosphates.

Interlaboratory comparisons of 45 South African laboratories showed good accuracy and precision in the analysis of synthetic water samples for total Kjeldahl nitrogen, ammonia, nitrate and nitrite nitrogen, total phosphate, and orthophosphate. Most laboratories used recognized current standard methods. Those organizations not using standard methods were urged to consider changing to standard methods. (Cassar-PTT)
W88-03646

REVIEW AND PERSPECTIVE ON THE USE OF MIXED-FUNCTION OXYGENASE ENZYMES IN BIOLOGICAL MONITORING,
Department of Fisheries and Oceans, St. John's (Newfoundland). Fisheries Research Branch.
J. F. Payne, L. L. Fancey, A. D. Rahimtula, and E. L. Porter.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 233-245, 1987. 4 fig, 105 ref.

Descriptors: *Water pollution effects, *Analytical methods, *Pollutants, *Pollution, *Biological oxidation, *Bioindicators, *Enzymes, Oxidation, Enzymes, Catalysts, Oxygenase enzymes, Mixed-function enzymes, Ecosystems.

Changes in simple biochemical/physiological responses may be useful for predicting the impacts of pollutants at population and community levels of biological organization. But there are serious conceptual constraints to such a thesis and it seems likely that such simple responses can go no further than serving as early warning systems for delineating potential areas of pollutant impact. Environmental testing is a prerequisite for any response suggested to have value as a biological monitoring index and the induction of mixed-function oxygenase (MFO) enzymes has now been validated in a large number of field studies worldwide. Diffuse sources of mixed organic pollution originating from industrial and domestic sources are being studies. Studies in the Great Lakes and Europe have demonstrated that the induction of MFO enzymes is a biological response of sufficient sensitivity to discriminate water quality differences over a broad geographical areas. As an early warning system, the induction of these enzymes can fullfill the requirement of 'most sensitive biological response' for assessing a variety of organic pollution conditions. Negative as well as positive field trials can be of value in addressing concerns about the toxicological significance of high-profile chemicals such as polycyclic aromatic hydrocarbons and organochlorines. (Author's abstract)
W88-03648

ACUTE AND CHRONIC TOXICITY OF NITRITE TO CLARIAS LAZERA,
Alexandria Univ. (Egypt).
A. M. Hilmy, N. A. El-Domiaty, and K. Wershana.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 247-253, 1987. 7 fig, 30 ref.

Descriptors: *Water pollution effects, *Pollutants, *Nitrites, *Toxicity, Clarias lazera, Fish, Pollution, Methemoglobin, Hypozia, Acute toxicity, Chronic toxicity.

Acute (96hr) and chronic (6-months) effects of nitrite were studied on two different sizes of juvenile Clarias lazera. Static biossays on acute toxicity showed median tolerance limit (TLm) for four days of 28 and 32mg/1 NO2-N for the two sizes respectively. Although nitrite has been known to cause hypozia, as a result of oxidation of haemoglobin to methemoglobin, exposure of both sizes to nitrite resulted in a decreased erythrocyte count haemoglobin content and haematrocit values. Fish exposed to nitrite responded physiologically by producing methemoglobin. A decline in serum total protein levels was recorded during acute and chronic exposure of both sizes to nitrite. This was interpreted as a generalized stress response. (Author's abstract)
W88-03649

ACUTE LETHAL TOXICITY OF SOME REFERENCE CHEMICALS TO FRESHWATER FISHES OF SCANDINAVIA,
Joensuu Univ. (Finland). Dept. of Biology.
A. O. J. Oikari.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 23-28, July 1987. 4 tab, 15 ref. Academy of Finland, Research council. Grant no. 06/085.

Descriptors: *Bioassay, *Water pollution effects, *Toxicity, *Reference chemicals, *Fish, Scandinavia, Dehydroabietic acid, Ecotoxicology, Trout.

Relevance of the choice of a test organism intended to be representative for a given environment seems to be under continual debate in aquatic exotoxicology. It is argued, for example, that use of rainbow trout, the species most commonly recommended as a standard cold water teleost is an alien in Nordic faunas. A comparative study with several freshwater species was conducted to clarify the validity of this assumption. Reference chemicals were used as a means of standardizing bioassays. The results indicate that fairly free choice can be made in selection of test species within narrow taxonomic groups concerning general screening of the acute toxicity of chemicals as well as their basic toxicity mechanisms. It is concluded that selection of rainbow trout for general toxicity study is valid. (Ray-PTT)
W88-03690

LEAD UPTAKE AND LEAD LOSS IN THE FRESH WATER FIELD CRAB, BARYTELPHUSA GUERINI, ON EXPOSURE TO ORGANIC AND INORGANIC LEAD,
Osmania Univ., Hyderabad (India).
S. J. Tulasi, R. Yasmeen, C. P. Reddy, and J. V. Ramana Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 63-68, July 1987. 1 fig, 21 ref.

Descriptors: *Bioassay, *Path of pollutants, *Lead, *Crab, *Organic lead, *Inorganic lead, Heavy metals, Bioindicators.

Fresh water field crabs were exposed to lead nitrate and lead acetate solutions (both 0.5 ppm) for 30 days. Lead contents of various parts of the crabs were analyzed to determine whether shells have any advantage over soft tissues as indicators for monitoring heavy metal content. It is concluded that shells have no advantage over soft tissues as an indicator of the organism's metal content. Because hemolymph lead levels directly reflected lead exposure and increased with exposure period, it is suggested that measurement of blood lead levels may be used as a sensitive method for determining lead toxicity in fresh water crab. (Ray-PTT)
W88-03696

COLIPHAGES AND BACTERIA IN GROUNDWATER FROM TEHRAN, IRAN,
Tehran Univ. (Iran).
For primary bibliographic entry see Field 5B.
W88-03698

OXIDATIVE PATHWAY AFTER REDUCTION OF P-AMINOBENZENE BY PSEUDOMONAS CEPACIA,
Gifu Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W88-03700

GROUND WATER QUALITY MONITORING: THE ARKANSAS APPROACH,
Arkansas Dept. of Pollution Control and Ecology, Little Rock.
For primary bibliographic entry see Field 7B.
W88-03757

SOIL GAS CONTAMINANT INVESTIGATIONS: A DYNAMIC APPROACH,
Tracer Research Corp., Tucson, AZ.
For primary bibliographic entry see Field 7B.
W88-03760

ACRIDINE ORANGE DIRECT COUNTS IN DRINKING WATER CONTROL PROGRAMMES - A METHOD TO CATCH UP WITH BACTERIAL DORMANCY,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
E. Kersholm, and H. Sogaard.
Aqua AQUAAA, No. 4, p 205-209, 1987. 3 fig, 3 tab, 16 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Acridine orange, *Drinking water, *Bacteria, Comparison studies, Metabolism, Plate counts, Water analysis.

Acridine orange direct counts were compared with plate counts in 234 drinking water samples. Plate counts were obtained on two different media (R2A and Kings agar B), and both the total AODC and the proportion of red-orange fluorescing bacteria were recorded. The correlation coefficients found were low (0.35-0.57) for all the tested combinations, but in accordance with the standard deviation they showed the closest agreement between the AODC and plate counts obtained on the R2A medium. It was shown that the total AODC remained constant over a 14-day period, when samples were fixed with 2% formaldehyde and stored at 4 C. Unfixed samples stored at 4 C showed a remarkable potential of growth, and the development in plate counts during the holding experiment is explained by awakening of dormant bacteria. It is proposed that the proportion of red-orange fluorescing cells represents the metabolically most active bacteria. (Author's abstract)
W88-03765

ASSESSMENT OF CHLORINATED PESTICIDES IN THE MAJOR SURFACE WATER RESOURCES OF THE ORANGE FREE STATE DURING THE PERIOD SEPTEMBER 1984 TO SEPTEMBER 1985,
National Inst. for Water Research, Pretoria (South Africa).
A. J. Hassett, P. T. Viljoen, and J. J. E. Liebenberg.
Water S. A. WASADV, Vol. 13, No. 3, p 133-136, July 1987. 4 fig, 5 tab, 12 ref.

Descriptors: *Pollutant identification, *Surface water, *Pesticides, *Organochlorine compounds, *Orange Free State, Water analysis, Atrazine, Water pollution sources, Seasonal variation, Chromatography.

During the period September 1984 to September 1985, monthly grab samples were taken from fifteen major surface water resources in the Orange Free State (OFS). Analyses for fourteen chlorinated pesticides were conducted by gas chromatography, electron capture detection. Sales figures for the more commonly used chlorinated pesticides were obtained for the years 1982 to 1984 as background information. Analytical results indicate high maximum values of Atrazine in surface waters in the northern and north-western OFS as well as a single point in the south-eastern OFS. Contamination occurred mainly during January and February. Concentrations of less than 0.8 microgram(ug)/L of pp'-DDT were detected in all samples but only during the period September to March. Endrin was detected on three separate occasions in single samples taken from three individual sampling points, at concentrations between 2-4 ug/L. Contamination by other chlorinated pesticides was infrequent, distributed randomly over the period and generally at concentrations below 0.1 ug/L. (Author's abstract)
W88-03766

KINETICS OF THE REACTION BETWEEN NITROGEN DIOXIDE AND WATER VAPOUR,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Inorganic Chemistry.
For primary bibliographic entry see Field 2K.
W88-03778

WINTER STUDY OF AIR, CLOUD AND PRECIPITATION CHEMISTRY IN ONTARIO, CANADA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W88-03779

BACKGROUND LEVELS OF AIR AND PRECIPITATION QUALITY IN EUROPE,
Institute for Atmospheric Physics, Budapest (Hungary).
For primary bibliographic entry see Field 2B.
W88-03780

APPLICATIONS OF IC IN ENVIRONMENTAL ANALYSIS,
R. A. Nadkarni, and J. M. Brewer.
American Laboratory ALBYBL, Vol. 19, No. 2, p 50, 52, 54, 56-59, February 1987. 7 fig, 6 tab, 20 ref.

Descriptors: *Ion chromatographic analyses, *Environmental analyses, *Chromatography, *Chemical analysis, *Industrial wastes, *EPA protocol, *Oil shale, *Organic acids, Wastewaters, Inorganic anion analyses, Water analysis.

Ion chromatographic procedure can be used successfully to replace conventional wet chemical methods of analyses of not only inorganic but also organic acids. The procedure has been used to analyze a large member of organic acids, for example, oxalic, citric, tartaric, pyruvic, lactic, acetic and at ppm levels in aqueous streams. In the determination of organic acids, 0.01 m HCl is used as an eluant. Formaldehyde is analyzed by this method by converting it first to bisulfite adduct. Presence of ethanolamine in refinery wastewaters is determined by mobile phase ion chromatography- a variation of the ion chromatographic procedure. Replacing a conventional conductivity detector with an electrochemical detector in the range of ion chromatography can be extended to include the analysis of cyanide, sulfide, bromide and phenols. This method is superior to conventional wet chemical procedures. It is also faster, more sensitive and capable of producing precisions of the order of + or - 2% relative standard deviation. (Ray-PTT)
W88-03819

APPLICATION OF ROBOTICS TO SAMPLE PREPARATION FOR ICP ANALYSIS,
E. Pruszkowski, D. A. Yates, and M. L. Salit.
American Laboratory ALBYBL, Vol. 19, No. 3, p 90, 92, 94, 96, March 1987. 3 fig, 3 tab, 1 ref.

Descriptors: *Robotics, *Sample preparation, *Automation, *Spectroscopy, *Water analysis, *Chemical analysis, *Plasma spectroscopy, Inductively couples plasma spectroscopy, Laboratory equipment, Computers.

Inductively coupled plasma spectroscopy in conjunction with an autosampler and a data acquisition system can analyze a large number of samples rapidly without human involvement. However, an important part of analysis, namely sample preparation still is usually done manually. Thus the sample preparation step really becomes the slowest and most tedious step in the analytical protocol. A robot-ICP system was devised to automate the sample preparation step and as a result the total analytical time was reduced considerably. The system was tested by analyzing trace metals in oil and water samples obtained from the National Bureau of Standards. The analytical results obtained by robot-ICP system matched very well with those of NBS. The interaction between the ICP and robot occurs via a set of specific commands embedded within the spectrometer and robot software. The automated system was programmed to follow the EPA procedure for water sample preparation exactly with two minor alternations: (1) a smaller amount of sample was used, and (2) an air flow was applied over the surface to facilitate evaporation. The automated sample preparation system consists of: robot and robot drive electronics, IBM PC system controller, Perkin-Elmer Robot Language (PERL) application software, accessory modules, and work surface. The IBM PC microcomputor has a 640 K memory and is equipped with up to ten RS-232C communication ports. (Ray-PTT)
W88-03820

FLOW INJECTION SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM IN NATURAL WATER USING ERIOCHROME CYANINE R AND CATIONIC SURFACTANTS,
Norsk Inst. for Skogforskning, Aas.
O. Royest.
Analytical Chemistry ANCHAM, Vol. 59, No. 6, p 899-903, March 1987. 7 fig, 2 tab, 18 ref.

Descriptors: *Flow injection analysis, *Water analysis, *Chemical analysis, *Spectrophotometric analysis, *Aluminum.

A flow injection spectrophotometric analytical method for the determination of aluminum in water uses erichrome cyanine R and cetyltrimethylammonium bromide. The measurements are performed at pH 7.5. At this acidity the interference from phosphate and fluoride ions is greatly reduced compared to the interference at pH 10. Of the 40 elements tested only iron, beryllium, lanthanum and cerium cause strong interference. The interference from iron can be masked by hydroxylammonium chloride/1,10-phenathroline. Dissolved organic carbon up to 20 mg/l can be tolerated. Interferences from organic acids, such as humic, oxalic, citric etc., are less at pH 7.5 than at 6.1. The detection limit is 1 microgram/L aluminum and calibration graphs are linear up to 0.8 or 4 mg/L (injection loop 200 or 10 microliter, respectively). Good reproducibility (relative standard deviation 0.7% at 1 mg/L) and high sample throughput (120/hr) were achieved. (Ray-PTT)
W88-03823

QUANTITATION OF TOXAPHENE IN ENVIRONMENTAL SAMPLES USING NEGATIVE ION CHEMICAL IONIZATION MASS SPECTROMETRY,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
D. L. Swackhamer, M. J. Charles, and R. A. Hites.
Analytical Chemistry ANCHAM, Vol. 59, No. 6, p 913-917, March 1987. 3 fig, 5 tab, 27 ref.

Descriptors: *Negative ion chemical ionization mass spectrometry, *Chemical analysis, *Mass spectrometry, *Toxaphene, *Selected ion monitoring, *Halogenated pesticide, Fish, Tissue analysis.

Quantitative determination of toxaphene was achieved by mass spectrometry using negative methane ion as an ionizing agent. Ions from each of the homologue groups in the toxaphene mixture having 6 to 10 chlorine atoms corresponding to the M(-) or the (M-Cl)(-) ion clusters (mass/charge ratio of 340, 341, 342, 343, 375, 377, 411, 413, 449) are monitored. Additional ions are monitored to correct for interferences from chlorinated pesticides (mass/charge ratio of 336, 338, 371, 373, 376, 412, 444, 448). Quantitation is done relative to an internal standard, 2, 2, 3, 4, 4, 5, 6, 6-octachloripiphenyl (mass/charge ratio 428 and 430). The negative ion chemical ionization response was linear over 4 orders of magnitude, and the detection limit was 75 picogram. This method is accurate and reproducible for measuring toxaphene in the presence of a major interferent, technical chlordane. The method is successful at measuring toxaphene in complex environmental matrices such as fish, and it can also be used to evaluate the changes in the relative homologue distribution that may have resulted from environmental transformations. A Hewlett-Packard 5985B gc-Ms system equipped with a 30 m by 0.25 mm DB-5 fused silica capillary column with helium as carrier was used for these analyses. (Ray-PTT)
W88-03824

MICROWAVE DIGESTION TECHNIQUES IN THE SEQUENTIAL EXTRACTION OF CALCIUM, IRON, CHROMIUM, MANGANESE, LEAD AND ZINC IN SEDIMENTS,

University of Southern Colorado, Pueblo. Dept. of Chemistry.
K. I. Mahan, T. A. Foderaro, T. L. Garza, R. M. Martinez, and G. A. Maroney.
Analytical Chemistry ANCHAM, Vol. 59, No. 7, p 938-945, April 1987. 20 fig, 3 tab, 15 ref. National Institute of Health DRR contract No. RR08197.

Descriptors: *Microwave digestion, *Sequential extraction, *Chemical analysis, *Heavy metals, *Sediments, *Extraction rates, *Calcium, *Iron, *Chromium, *Manganese, *Lead, *Zinc.

The conventional procedure for determining heavy metals in sediments consists of the sequential extraction of the sediments with various chemicals under specified conditions. This procedure is very time consuming, the slowest step being the heating of the sediment-chemical for extended periods of time. Since microwave heating is very rapid, this procedure was compared with conventional heating. Experiments using the two procedures produced comparable results. Recoveries of total metals from NBS SRM 1645 river sediment ranged from 76% to 120% for the conventional procedure and 62% to 120% for the microwave procedure. Recoveries of total metals using the microwave and conventional techniques were reasonably comparable except for iron (62% by microwave vs. 76% by conventional). Recovery of iron from the residual fraction is virtually complete if aqua regia/HF digestion is used instead of HNO(3)/HCl alone. Precision obtained from 31 replicate samples of the California Gulch, Colorado, sediment yielded about an average 11% relative standard deviation excluding the exchangeable fraction was more variable. (Ray-PTT)
W88-03825

METHOD FOR DETERMINATION OF OXYGEN-18 OF HYDROGEN PEROXIDE IN RAINWATER,

Argonne National Lab., IL. Chemical Technology Div.
B. D. Holt, and R. Kumar.
Analytical Chemistry ANCHAM, Vol. 59, No. 7, p 995-999, April 1987. 6 fig, 22 ref.

Descriptors: *Oxygen isotopes, *Hydrogen peroxide, *Rain, *Acid rain, *Water pollution sources, *Sulfates, Mass spectroscopy, Isotope studies, Sulfur dioxide.

An analytical method was developed to determine the deviation in the oxygen isotope of mass 18 of hydrogen peroxide in rainwater. This information may be used to assess the relative importance of hydrogen peroxide in oxidative processes in the atmosphere by which sulfur/dioxide is transformed into sulfate ion. 20 liter samples of rainwater, acidified with H2SO4 and refrigerated at about 5 C until time of analysis, were filtered, quantitatively degassed of dissolved air by a combination of evacuation, ultrasonic agitation, and helium sparging (VUS); and treated with pulverized crystals of KMnO(4). The oxygen, produced by KMnO(4) oxidation of H2O2 in the water, was removed from solution by this VUS treatment, converted to CO2 in the helium stream by passing over graphite and platinum at 600 C, and cryogenically separated for subsequent measurements of concentration and deviation of oxygen isotope of mass 18 in H2O2 in the rainwater. Isotopic results obtained on the H2O2, SO4(-2), and H2O of rainwater samples from Illinois, Michigan, New York, and North Carolina, during the summer of 1985, indicated that 40% or more of the sulfate in precipitation was formed by H2O2 oxidation of SO2 in the atmosphere. (Author's abstract)
W88-03826

DETERMINATION OF ORGANIC COMPOUNDS LEACHED FROM MUNICIPAL INCINERATOR FLY ASH BY WATER AT DIFFERENT PH LEVELS,

Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 5B.
W88-03827

IMPROVED SPARGER FOR PURGE AND TRAP CONCENTRATOR USED FOR THE ANALYSIS OF VOLATILE ORGANICS IN LANDFILL LEACHATES AND SEPTIC SAMPLES,

Connecticut Univ., Storrs. Dept. of Chemistry.
D. J. Chichester-Constable, M. E. Barbeau, S.-L. Liu, S. R. Smith, and J. D. Stuart.
Analytical Letters ANALBP, Vol. 20, No. 3, p 403-425, March 1987. 5 fig, 2 tab, 22 ref. USGS Grant No. 14-08-0001-g-832.

Descriptors: *Volatile organics, *Pollutant identification, *Chemical analysis, *Leachates, *Landfills, *Flame ionization gas chromatography, *Groundwater pollution, Gas chromatography, Wastewater analysis, Industrial wastewater.

Determination of volatile organics in groundwater and wastewater samples using the purge and trap procedure is an EPA approved method and is practiced widely. But for some types of wastewaters, especially, industrial wastewaters present difficulties when this method is employed. This procedure was modified by introducing an improved sparger, utilizing an inexpensive and reusable large glass culture tube for sample collection and using it also for storage and for purging operation. These modifications permitted the successful analysis 'dirty' landfill leachates and septic samples. (Ray-PTT)
W88-03834

IDENTIFICATION OF TRACE ORGANIC CONTAMINANTS IN INORGANIC WATER TREATMENT CHEMICALS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,

Waterloo Univ. (Ontario).
T. S. Thompson, and F. W. Karasek.
Journal of Chromatography JOCRAM, Vol. 388, No. 2, p 351-363. Feb. 13, 1987. 2 fig, 8 tab, 15 ref.

Descriptors: *Pollutant identification, *Drinking water, *Water treatment chemicals, *Water pollution sources, *Organic compounds, Gas chromatography, Mass spectroscopy, Electron impact ionization, Positive ion chemical ionization, Chlorinated hydrocarbons.

One of the possible sources of organic contaminants in drinking water is the inorganic chemicals used for water treatment. A method to identify organic contaminants in these inorganic chemicals uses gas chromatography-mass spectrometry. Both the electron impact and chemical ionization techniques were used. The majority of the organic chemical contaminants present contained only carbon, hydrogen and oxygen, and in some cases nitrogen. In the twenty-four samples analyzed only a total of three chlorinated species were identified. The total organic content of the various chemicals studied ranged from 0.01 to 300 ppm, however, most samples contained < 10 ppm. (Ray-PTT)
W88-03838

APPLICATION OF LIQUID CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION TO THE ANALYSIS OF OIL SHALE PROCESS WATER,

Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Div. of Energy Chemistry.
G. E. Batley.
Journal of Chromatography JOCRAM, Vol. 389, No. 2, p 409-416. March 13, 1987. 1 fig, 6 tab, 17 ref.

Descriptors: *Oil shale process waters, *Industrial wastewater, *Pollutant identification, *Liquid chromatography, *Electrochemical detection, Phenols.

Analysis of oil shale process water is very complicated because a large number of organic compounds are present in varying quantities from parts-per-billion to higher concentrations. Analysis by gas chromatography-mass spectroscopy procedures does not always identify all the organic components in these waste waters. A liquid chromatographic procedure along with electrochemical detection was developed to identify, unambiguously, all the components. Among the compounds exhibiting electrochemcial reactivity are phenols, aromatic amines, and heterocyclic bases such as piperidine and pyrrolidine and their derivatives. (Ray-PTT)
W88-03839

AMPICILLIN-DEXTRIN AGAR MEDIUM FOR THE ENUMERATION OF AEROMONAS SPECIES IN WATER BY MEMBRANE FILTRATION,

Rijksinstituut voor de Volkagezondheid en Milieuhygiene, Bilthoven (Netherlands).
A. H. Havelaar, M. During, and J. F. M. Versteegh.
Journal of Applied Bacteriology JABAA4, Vol. 62, No. 3, p 279-287, March 1987. 7 tab, 32 ref.

Descriptors: *Bacterial analysis, *Membrane filtration, *Aeromonas, *Ampicillin-dextrin agar medium, *Human pathogens, Culture media, Disease.

Large numbers of aeromonads occur in drinking water, fresh water, saline water and in a variety of other sources such as soil and food. In order to study the ecology of Aeromonas bacteria in water, simple, but accurate and reliable, isolation and identification procedures are needed. Published selective media for the isolation of Aeromonas from environmental samples by membrane filtration were reviewed. Satisfactory recoveries were obtained only with mA agar and dextrin-fuchsin-sulfite agar, but neither was sufficiently selective. The positive aspects of these two media were combined by the in a new medium, ampicillin-dextrin agar. Recovery from pure cultures and environmental samples was optimal at an ampicillin concentration of 10 mg/L and incubation for 24 hr at 30 C under aerobic conditions, and specificity was high (confirmation rate usually > 90%). This medium can also be used for isolation of Aeromonas bacteria from sea water provided that the

vibriostatic agent o/129 is added at 50 mg/L. (Ray-PTT)
W88-03840

WASTEWATER ANALYSIS WITH ROBOTICS AND GAS CHROMATOGRAPHY,
Mobay Corp., New Martinsville, WV. Environmental Research Lab.
W. R. Hornbrook, and R. H. Ode.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 5, p 206-209, May 1987. 2 fig, 2 tab, 7 ref.

Descriptors: *Wastewater analysis, *Gas chromatography, *Robotics, Microextraction, Biological reactor, Pollutant identification, Biological wastewater treatment, Organic compounds, Computers.

In order to assess the effectiveness of biological treatment of wastewater extensive analysis of the feed and effluent for priority organic pollutants is required. Gas chromatography is the recommended procedure for these analysis. However, this procedure requires time consuming sample preparation techniques. An automated sample preparation scheme was developed using a Zymate Robotic System and successfully applied to the preparation of wastewater samples. The sample preparation time has been reduced from 10 hr. for 24 samples to 4-5 hr. The quality of the data is equivalent to, or better than, comparable manual procedures. (Ray-PTT)
W88-03841

NUMERICAL ESTIMATION TO ORGANIC POLLUTION OF FLOWING WATER BY USING THE EPILITHIC DIATOM ASSEMBLAGE — DIATOM ASSEMBLAGE INDEX (DAIPO),
Nara Women's Univ. (Japan). Dept. of Biology.
I. Watanabe, K. Asai, and A. Houki.
Science of the Total Environment STENDL, Vol. 55, p 209-218, 1986. 7 fig, 7 ref.

Descriptors: *Bioindicators, *Pollution index, *Organic pollutants, *Rivers, *Lakes, *Water quality, Water pollution, Numerical analysis, Number index.

A numerical index to organic pollution of flowing water is based on the correlation between biological oxygen demand and relative abundance of epilithic diatom taxon in river and lake basins. Diatom taxa were classified into three ecological groups: (1) Saprophilous, (2) Eurysaprobic, and (3) Saproxenous. Cluster analysis of 452 diatom taxa in 472 water samples was used to derive the diatom assemblage index to organic water pollution (DAIpo). An examination of the allocation of diatom taxa and DAIpo values derived by this cluster analysis indicated that Saprophilous taxa do not commonly occur together with saproxenous taxa in the diatom assemblage. When the value of DAIpo is 50, the relative abundance of eurysaprobic taxa reaches a maximum. In this case, taxa belonging to the other two groups hardly appear. The relative abundances of the three components in diatom assemblages increase or decrease systematically with the change of DAIpo values. The DAIpo values at various sampling stations were used to draw a water quality map, to show the show the present condition of river pollution. However, it was not possible to obtain an accurate comparison of the degree of pollution between rivers with different lengths using these water quality maps. Another index was developed, RPI sub D, which could be used to determine the range of the degree of water pollution over the course of a stream and to compare the degree of pollution in rivers with different lengths. (Ray-PTT)
W88-03859

SURVEY OF FARM WELLS FOR PESTICIDES RESIDUES, SOUTHERN ONTARIO, CANADA, 1981-1982, 1984,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Agricultural Lab. Services Branch.
For primary bibliographic entry see Field 5B.
W88-03864

MIXTURE TOXICITY INDICES IN ACUTE LETHAL TOXICITY TESTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
B. G. E. de March.
Archieves of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 35-37, January 1987. 1 fig, 2 tab, 13 ref.

Descriptors: *Mixture Toxicity Indices, *Toxicity, *Mathematical models, Response surface equations.

Methods for defining Mixture Toxicity Indices (MTI's), which could be used in a similar manner as other critical concentration values, e.g. LC50's are illustrated using a series of mathematical equations. For an MTI to apply to all possible mixtures of the compounds in question, it must summarize information from a model describing all possible responses of interest. A method of obtaining MTI's from response surface equations or from tolerance models similar to the toxic units model is presented. Methods of calculating several MTI's from multivariable probit response surfaces are demonstrated. (Ray-PTT)
W88-03866

ASSESSMENT OF THE BIOLOGICAL IMPACT OF POINT SOURCE DISCHARGES EMPLOYING ASIATIC CLAMS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
C. Foe, and A. Knight.
Archieves of Environmental and Contamination Toxicology AECTCV, Vol. 16, No. 1, p 39-51, Jan. 1987. 4 fig, 6 tab, 53 ref. California Water Resource Board Grant No. 2-119-12--0.

Descriptors: *Asiatic clams, *Water temperature, *Condition index, Water pollution effects, *Bioassay, *Thermal pollution, *Powerplants, Temperature effects, Clams, Mortality.

Three thousand Asiatic clams were transplanted for 6 mo along a stress gradient produced by the thermal discharge of a power plant in the Western Sacramento-San Joaquin Delta, California, to ascertain whether Asiatic clams could be employed to monitor the biological impact of point source discharges. Water temperature at the warmest site was between 25 and 35 C, 7-13 C above that in the river. Almost complete clam mortality was recorded here within 60 days. Water temperature at the next cooler site was elevated 0.5-2 C above ambient river temperature. Adult and juvenile clam shell and tissue growth and condition index was less here ($P < 0.05$) than at cooler sites where all three parameters were similar ($P > 0.1$). A one time measurement of juvenile clam scope for growth (SFG) also demonstrated a decreasing trend along the thermal gradient. SFG was positively correlated with juvenile clam shell and tissue growth but not with condition index. (Author's abstract)
W88-03867

SIMULTANEOUS DETERMINATION OF GALLIUM AND ZINC IN BIOLOGICAL SAMPLES, WINE, DRINKING WATER, AND WASTEWATER BY DERIVATIVE SYNCHRONOUS FLUORESCENCE SPECTROMETRY,
Malaga Univ. (Spain). Dept. of Analytical Chemistry.
E. U. Pozo, A . Garcia de Torres, and J. M. C. Pavon.
Analytical Chemistry ANCHAM, Vol. 59, No. 8, p 1129-1133, April 1987. 3 fig, 2 tab, 27 ref.

Descriptors: *Fluorescence spectroscopy, *Chemical analysis, *Spectroscopy, *Gallium, *Zinc, *Drinking water, *Wastewater, Metals.

A simple, rapid, sensitive, and selective method for the simultaneous determination of gallium and zinc using derivative synchronous fluorescence spectrometry is based upon the formation of fluorescent complexes of gallium and zinc ions with salicylaldehyde thiocarbazone. The reaction is carried out at pH 4.7 in aqueous ethanol medium (52% v/v of ethanol). The use of second-derivative synchronous fluorescence spectrometry permits the simultaneous determination of gallium and zinc in the concentration intervals of 2-40 and 20-1500 nonagram/ml, respectively. The effect of interferences was studied and the tolerance limits causing a deviation of < + or - 5% are tabulated. The tolerance level for some metal ions can be increased by addition of fluoride, thiosulfate, dimethylglyoxime, ioxide, or ethylenediametetracetic acid (EDTA). The method was used to determine gallium and zinc in biological samples (after decomposition of the organic matter by nitric acid and hydrogen peroxide mixture), wine, drinking water, and wastewater and were in agreement with the results obtained by atomic absorption. (Author's abstract)
W88-03882

RECOVERY STUDIES OF VOLATILE ORGANICS IN SEDIMENTS USING PURGE/TRAP METHODS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
M. J. Charles, and M. S. Simmons.
Analytical Chemistry ANCHAM, Vol. 59, No. 4, p 1217-1221, April 1987. 3 fig, 5 tab, 35 ref.

Descriptors: *Volatile organics, *Sediments, *Chemical analysis, *Chlorinated hydrocarbons, Purge/trap method, Chloroform, Trichloroethylene, Chlorobenzene.

Low molecular weight volatile chlorinated hydrocarbons are common contaminants of environmental interest because they are mutagents, carcinogens, and teratogens and are not readily degraded. Studies addressing their migration in aquatic and terrestrial systems are much needed and require an analytical method applicable to all types of environmental matrices. Static and dynamic headspace methods for the analyses of liquids are well-developed. Modifications of these methods have been used on other matrices, soils, sediments, for example, without considering matrix effects. Such a procedure can result in erroneous conclusions. Effects of sediment type, analyte, and conductivity of the desorbing solution on the recovery of representative volatile organics in sediment systems using the purge-and-trap method were determined. Only the type of compound affected recovery. Overall recoveries for sorbed compounds on three different sediments were 38% for chloroform, 48% for trichloroethylene, and 54% for chlorobenzene. (Ray-PTT)
W88-03883

INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1973-74,
Geological Survey, Richmond, VA. Water Resources Div.
R. A. Krieger.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Professional Paper 427-D, 1985. 63 p, 33 ill, 36 tab, 11 ref.

Descriptors: *Acid mine drainage, *Kentucky, Aquatic life, Strip mine wastes, Sediment discharge, Water quality, Land reclamation, Runoff, Geohydrology, Environmental effects, Appalachia, Cumberland River Basin.

The Beaver Creek study includes 29 years of measurements of the effects of strip mining on the hydrologic and ecologic systems of a small stream basin in mountainous eastern Kentucky. This report describes the work during 1973-74 and summarizes the observations and conclusions of the full 29 years. The immediate effect of strip mining is the transport of large amounts of sediment and acid from the spoil pile to the streams. Aquatic organisms in the streams are often eliminated. Within 10 years there was a noticeable reduction in sediment yield. At 29 years, sediment deposits in the stream channels were removed, and sediment yields significantly reduced. Acid mine drainage, however, declined more slowly. At the 29th year, aquatic organisms are still absent in most affected

area. Acid water in Beaver Creek is the most important and lasting problem. (USGS)
W88-03906

WATER TREATMENT PLANT OPERATION REVIEW MANUAL FOR OPERATORS,
Michigan Dept. of Public Health, Lansing. Section of Water Supply.
For primary bibliographic entry see Field 5F.
W88-03981

TESTING FOR GROUNDWATER CONTAMINATION AT HAZARDOUS WASTE SITES,
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
J. R. Garman, T. Freund, and E. W. Lawless.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 328-337, August 1987. 1 fig, 5 tab, 5 ref.

Descriptors: *Environmental Protection Agency, *Groundwater quality, *Water pollution control, *Regulations, *Disposal sites, *Hazardous wastes, Resource Conservation and Recovery Act, Chemical analysis.

The U.S. EPA issued a new list of chemical substances for use in connection with monitoring groundwater contamination at hazardous waste sites. This list is Appendix IX to Part 264 of Title 40 of the Code of Federal Regulations and was developed to implement the Resource Conservation and Recovery Act. The role of Appendix IX under the Regulation is described and the history of its preparation is discussed. The general nature of the analytical procedures is described. Some data for distribution of substances found in the groundwater at 38 sites with > 5,000 wells showed that widely found. These substances are tabulated. (Lantz-PTT)
W88-04003

CHROMATOGRAPHIC MONITORING METHODS FOR ORGANIC CONTAMINANTS UNDER THE SAFE DRINKING WATER ACT,
Environmental Protection Agency, Cincinnati, OH. Office of Drinking Water.
R. Reding.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 338-344, August 1987. 2 fig, 4 tab, 26 ref.

Descriptors: *Monitoring, *Pollutant identification, *Water quality control, *Gas chromatography, Safe Drinking Water Act, Organic compounds, Volatile organics, Chemical analysis, Pesticides, Polychlorinated biphenyls, Trihalomethane.

Five volatile organic chemical (VOC) and six synthetic organic chemical (SOC) analytical methods for the determination of certain organic contaminants are discussed. These methods are additions and improvements to methods previously developed by the U.S. EPA for the measurement of trihalomethane, VOC, pesticides, and polychlorinated biphenyl (PCB) contaminants in drinking water. The major changes are the use of smaller sample volumes in some analyses and the increased use of capillary gas chromatographic columns. (Author's abstract)
W88-04004

REVERSED-PHASE SOLID-PHASE EXTRACTION FOR AQUEOUS ENVIRONMENTAL SAMPLE PREPARATION IN HERBICIDE RESIDUE ANALYSIS,
Auburn Univ., AL. George W. Andrews Forestry Science Lab.
M. J. M. Wells, and J. L. Michael.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 345-350, August 1987. 4 fig, 3 tab, 20 ref.

Descriptors: *Solid-phase extraction, *Herbicides, *Pollutant identification, *Sample preparation, Chromatography, Organic compounds.

Solid-phase extraction is an emerging chromatographic sample preparation technology. It is an improved alternative to traditional methods of extracting and concentrating organic compounds from aqueous solutions. Successful application of solid-phase extraction to aqueous environmental samples is illustrated for the trace enrichment of herbicide residues. Because retention and elution are confounded during solid-phase extraction method development, it is difficult to optimize one before the other. A plan for developing single-residue analytical protocols is illustrated using the herbicides chlorsulfuron, sulfmeturon methyl, and AC 243,997 and the application os this plan to the reversed-phase solid-phase extraction of trace residues from aqueous environmental samples is demonstrated. The plan involves controlling the factors influencing retention by solid-phase extraction while elution is first optimized. Once elution is optimized, the parameters controlling retention are varied for optimization. The influence of pH, sample concentration and volume, sorbent mass, and solvent strength and volume on the removal of thrace organics from water is discussed. (Lantz-PTT)
W88-04005

FACTORS INFLUENCING CAPILLARY ANALYSES OF VOLATILE POLLUTANTS,
Supelco, Inc., Bellefonte, PA.
N. H. Mosesman, L. M. Sidisky, and S. D. Corman.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 351-355, August 1987. 8 fig, 3 tab, 9 ref.

Descriptors: *Pollutant identification, *Capillary analysis, *Chemical analysis, *Volatile organics, Temperature, Flow rate, Measuring instruments.

Factors influencing analyses of volatile pollutants by wide-bore capillary chromatography and purge-and-trap techniques are determined and optimized. These factors include the initial column temperature, the carrier gas flow rate, the speed with which the compounds are desorbed from the rap, and the type of detector used. A carrier gas flow of 10 ml/min and an initial column temperature of 10 C are the optimum conditions to use for purge-and-trap analyses of volatile priority pollutants from a 0.75-mm i.d. VOCOL capillary column. Once all of these factors are optimized, volatile pollutants are readily analyzed. (Lantz-PTT)
W88-04006

DETERMINATION OF PURGEABLE HALOCARBONS AND AROMATICS BY PHOTOIONIZATION AND HALL ELECTROLYTIC CONDUCTIVITY DETECTORS CONNECTED IN SERIES,
Acurex Corp., Mountain View, CA. Environmental Systems Div.
V. Lopez-Avila, N. Heath, and A. Hu.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 356-363, August 1987. 2 fig, 8 tab, 8 ref.

Descriptors: *Halocarbons, *Aromatic compounds, *Pollutant identification, *Chemical analysis, Conductivity, Measuring instruments.

The purge-and-trap technique, combined with a photoionization detector (PID) and a Hall electrolytic conductivity detector (EICD) connected in series was investigated for the determination of 46 volatile organic compounds. Both packed and open tubular capillary columns were evaluated. Twenty compounds arranged in nine groups coeluted on the 1% SP-1000 on Carbopack B column, and 15 compounds arranged in five groups coeluted on the n-octane/Porosil column. Preliminary experiments with wide-bore capillary columns indicate that either the VOCOL or the DB-624 open tubular capillary column can be used for the primary analysis of Methods 8010 and 8020 compounds. However, neither column is able to completely resolve all compounds. Twenty compounds arranged in eight groups coeluted on the VOCOL (diphenyl dimethyl polysiloxane with crosslinking moieties, Supelco, Inc) open tubular capillary column and 11 compounds arranged in five groups coelute on the DB-624 (cyanopropyl phenyl dimethyl polysiloxane, J&W Scientific) open tubular capillary column. Method precision of the purge-and-trap technique with a PID and a Hall EICD connected in series, as assessed from the instrument response at a known concentration per compound, is better than + or - 30% (except for dichloromethane) and has a mean value of + or - 12%. Method accuracy ranges from 82 to 104% for groundwater samples. Method detection limits vary with each compound and range from 0.1 to 0.9 ppb for water samples and 1 to 5 ppm for soil samples. (Author's abstract)
W88-04007

ANALYSIS OF PURGEABLE ORGANICS IN WATER BY CAPILLARY GC/PID-EICD,
HNU Systems, Inc., Newton, MA.
J. N. Driscoll, M. Duffy, S. Pappas, and M. Webb.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 369-380, August 1987. 7 fig, 4 tab, 13 ref.

Descriptors: *Organic compounds, *Water analysis, *Pollutant identification, *Gas chromatography, *Photoionization, Measuring instruments, Chemical analysis, Groundwater quality, Groundwater pollution, Aromatic compounds, Alkanes.

Some aspects involved in converting US EPA Methods 601 and 602 to the use of capillary columns instead of packed columns are discussed. The conversion optimizes the methods so that a photoionization detector (PID) and an electrolytic conductivity detector (EICD) can be run in series. Also discussed is a modification of Method 602 to permit the analysis of aromatics in gasoline-contaminated groundwater samples that contain significant quantities of alkanes. The substitution of a 530-micrometer fused-silica capillary column for a packed column results in improvements in resolution, sensitivity, speed of analysis, and reliability. (Author's abstract)
W88-04008

NUMERICAL TECHNIQUE TO CORRECT FOR WEAK ACID ERRORS IN GRAN FUNCTION ANALYSIS OF TITRATION DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
J. J. Bisogni, and T. E. Barnard.
Water Research WATRAG, Vol. 21, No. 10, p 1207-1216, October 1987. 8 fig, 4 tab, 15 ref.

Descriptors: *Water analysis, *Weak acids, *Acid rain, *Aqueous solutions, *Gran function, *Titration, *Acidity, Chemical analysis, Mathematical studies, Model studies, Carbon dioxide.

The separation of acidity of aqueous samples into strong and weak acid components by ordinary Gran functions analysis has been shown to give erroneous results. A numerical method is presented which fits titration data to a multi-monoprotic weak acid model. The method accumulates weak acids by assigning a series of monoprotic dissociation constants. The major attributes of the modeling approach presented here are: (1) no assumptions concerning the initial amount of strong acid, nor number and relative concentrations of weak acids are required; and (2) the method accommodates the problem of CO2 contamination in strong base titrant and accounts for its effects on titration data. (Lantz-PTT)
W88-04023

PHOSPHATE EXCHANGE CHARACTERISTICS OF WET AND DRIED SEDIMENT SAMPLES FROM A HYPERTROPHIC RESERVOIR: IMPLICATIONS FOR THE MEASUREMENTS OF SEDIMENT PHOSPHORUS STATUS,
National Inst. for Water Research, Pretoria (South Africa).
A. J. Twinch.
Water Research WATRAG, Vol. 21, No. 10, p 1225-1230, October 1987. 3 fig, 1 tab, 19 ref.

Descriptors: *Phosphates, *Sediments, *Chemical analysis, *Reservoirs, *Hartbeespoort Dam, *Hy-

pereutrophic reservoirs, Sample preparation, Eutrophic lakes, Lake sediments, Nutrient cycling, Dehydration.

Changes in the phosphate exchange characteristics induced in sediment samples by drying during preparation for analysis, are examined. Comparison of selected sediment parameters measured in wet and dried subsamples of a range of sediments from hypereutrophic Hartbeespoort Dam showed that air drying resulted in major changes in their physical and chemical composition. Particle size distribution in the dried sediments showed a shift toward larger particles, particularly in samples in which smaller particles were abundant, indicative of irreversible aggregation of finer particles. Drying decreased the bioavailable phosphorus (NTA-extractable) content of sediments but reduced the phosphate buffering capacity and increased the phosphate equilibrium concentrations by a factor of 3, thereby increasing the phosphate release potential of dried sediments. Since sediment phosphorus status is often studied with a view to assessing the role of sediments in phosphorus cycling and eutrophication control, it is concluded that inappropriate decisions could result from the use of dried samples for analysis. The implications of these results in the marginal zones of lakes, which experience natural dehydration during periods of draw-down, are discussed. (Author's abstract)
W88-04025

DETERMINANTS OF THE MICROBIOLOGICAL CHARACTERISTICS OF SPA POOLS IN SOUTH AUSTRALIA,
South Australian Health Commission, Adelaide.
For primary bibliographic entry see Field 5B.
W88-04026

MICROCOMPUTER-INTERFACED CONTINUOUS FLOW TOXICITY TEST SYSTEM,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
W. H. Hong, P. G. Meier, and R. A. Deininger.
Water Research WATRAG, Vol. 21, No. 10, p 1249-1257, October 1987. 9 fig, 12 ref.

Descriptors: *Monitoring, *Bioindicators, *Microcomputers, *Continuous flow, *Toxicity, Water quality control, Bioassays, Computers, Costs, Flow rates, Water quality.

While continuous-flow tests for toxicity evaluation are preferable over static tests, their use has been limited due to problems associated with their operation. Fluctuations in toxicant concentrations during exposure periods require frequent analyses and represent a drawback in conventional diluter systems. To reduce toxicant fluctuations and to maintain suitable water quality during long-term test periods, a low cost microcomputer-interfaced monitoring system (MIMS) was installed on a Benoit type serial diluter. The system monitored flow rates of test solutions and measured a number of water quality parameters. The MIMS system provided up-to-date information on whether the test was progressing well and indicated when diluter maintenance was needed. The MIMS interfaced diluter system performed well in long-term continuous-flow tests with minimal disruption and eliminated experimental failure. (Author's abstract)
W88-04028

APPLICATION OF TRACER TECHNIQUES TO CONTINUOUS-FLOW TOXICITY TESTING,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
P. G. Meier, W. H. Hong, and R. A. Deininger.
Water Research WATRAG, Vol. 21, No. 10, p 1259-1264, October 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Tracers, *Continuous flow, *Bioindicators, *Toxicity, *Monitoring, Water quality control, Chemical analysis, Statistical analysis, Dye tracers, Bioassays, Rhodamine WT, Lethal limits, Minnows.

Frequent toxicant analyses are essential for good quality data in long-term continuous-flow tests. Due to the time consuming and costly chemical analyses, exposure levels are measured at best on a daily basis. These infrequent determinations may not detect variability in toxicant concentrations that could result in test failures. To minimize repetitive testing and improve data quality, a dye tracer method was evaluated. Rhodamine WT was selected as a toxicant tracer because of easy detectability, low toxicity to aquatic organisms, and negligible transformation in the aquatic environment. Results over a 24 h period showed that rhodamine reliably predicted the toxicant (diquat) concentrations with an r value of 0.99. Based upon these data, two replicate long-term tests with and without tracer were carried out exposing fathead minnows Pimephales promelas to diquat (1:1'ethylene-2:2'-dipiridium dibromide). The test results indicated that the added rhodamine WT did not alter the diquat toxicity to fathead minnows using LC sub 50 and EC sub 50 values for comparisons. From these findings, it is concluded that dye tracers are suitable toxicant surrogates. Their use in flow-through tests allow more frequent analyses which result in better data and minimizes experimental failure. (Author's abstract)
W88-04029

TRACE METALS: CD, CU, PB AND ZN IN GELATINOUS MACROPLANKTON FROM THE NORTHWESTERN MEDITERRANEAN,
Institut National de la Sante et de la Recherche Medicale, Paris (France).
M. Romeo, M. Gnassia-Barelli, and C. Carre.
Water Research WATRAG, Vol. 21, No. 10, p 1287-1292, October 1987. 5 tab, 31 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Cadmium, *Biological magnification, *Bioaccumulation, *Copper, *Lead, *Zinc, *Macroplankton, *Mediterranean Sea, Heavy metals, Tunicates, Cnidarians, Ctenophores, Mollusks.

Gelatinous macroplankton organisms were collected in May 1984 in Villefranche-sur-Mer Bay and analyzed for cadmium, copper, lead and zinc. Analyses were carried out by polarography for Cd, Cu and Pb and by flame atomic absorption for Zn. Phosphorus was also measured in the samples as a biomass parameter due to difficulties inherent in measuring dry weight of gelatinous organisms. The samples contain Tunicates, Cnidarians (Hydromedusae, Siphonophores and Scyphomedusae), Ctenophores and Mollusks. Crustaceans living on some Tunicates were also sampled. With regard to Cd, Cu and Pb, mean concentrations did not show significant differences among the phyla studied: especially for Tunicates with mean values of 0.1 ng Cd/microgram P, 2.0 ng Cu/microgram P and 0.9 ng Pb/microgram P, for Cnidarians (Hydrozoa: Siphonophores) with mean values of 0.4 nanograms Cd/microgram P, 1,6 nanograms Cu/microgram P and 1.0 nanograms Pb/microgram P and for Cnidarians (Hydrozoa: Siphonophores) with mean values of 0.5 nanograms Cd/microgram P, 2.5 nanograms Cu/micrograms P, and 0.6 nanograms Pb/microgram P. On the other hand, mean zinc concentrations were significantly lower in Tunicates (7.9 nanograms Zn/microgram P) than in Cnidarians (3.68 nanograms Zn/microgram P). Zinc seems to be preferentially concentrated in organisms which are rich in the collagen constituting the mesoglea, such as in Cnidarians, Ctenophores, and gelatinous Mollusks, rather than in organisms rich in tunicin such as the Tunicates. (Lantz-PTT)
W88-04033

DETERMINATION OF NITRATE IN WATER USING AMMONIA PROBES AND REDUCTION BY TITANIUM (III),
Iowa State Univ., Ames. Dept. of Botany.
W. G. Crumpton, T. M. Isenhart, and C. M. Hersh.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 905-908, October 1987. 1 fig, 2 tab, 9 ref. Iowa State Water Resources Research Inst. Project No. G-1225-05 and Army Corps of Engineers Contract No. DACW25-86-0007.

Descriptors: *Water analysis, *Nitrates, *Pollutant identification, *Chemical analysis, Monitoring, Titanium, Ammonia.

A procedure is described for the determination of nitrate in water at concentrations between 0.02 and 30 mg/L NO3-N. Nitrate is converted to ammonia by alkaline reduction with TiCl3 in gas tight reaction vials. Ammonia is determined before and after reduction using a gas-sensing probe and nitrate is calculated by difference. The procedure is simple, inexpensive, and suitable for routine analysis of samples as small as 5 ml. There are no significant interferences and results are comparable to those obtained using automated cadmium reduction. (Author's abstract)
W88-04074

ENVIRONMENTAL CONTAMINATION BY POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS ASSOCIATED WITH PULP AND PAPER MILL DISCHARGE,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W88-04078

SURVIVAL OF CANDIDA ALBICANS IN TROPICAL MARINE AND FRESH WATERS,
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
For primary bibliographic entry see Field 5B.
W88-04082

BENZTHIAZOLES IN ESTUARINE SEDIMENTS AS INDICATORS OF STREET RUNOFF,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-04095

MUSSELS AS BIOINDICATORS OF PCB POLLUTION: A CASE STUDY ON UPTAKE AND RELEASE OF PCB ISOMERS AND CONGENERS IN GREEN-LIPPED MUSSELS (PERNA VIRIDIS) IN HONG KONG WATERS,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
S. Tanabe, R. Tatsukawa, and D. J. H. Phillips.
Environmental Pollution (Series A) EPEBD7, Vol. 47, No. 1, p 41-62, 1987. 10 fig, 3 tab, 49 ref. Ministry of Education, Science and Culture of Japan Grant 60030060.

Descriptors: *Bioindicators, *Polychlorinated biphenyls, *Mussels, *Fate of pollutants, *Water quality, *Path of pollutants, Pollutant identification, Mollusks, Hong Kong, Accumulation, Bioaccumulation, Lipids, Water pollution, Monitoring, Chemical analysis, Kinetics.

The uptake and release of PCB isomers and congeners were examined in green-lipped mussels (Perna viridis) through a transplantation experiment in two locations in Hong Kong waters. Rapid rates of uptake and release of relatively less lipophilic lower-chlorinated PCBs were observed in the mussels, indicating that the primary mechanism for bioaccumulation of lipophilic pollutants in P. viridis complies with the concept of equilibrium partitioning. Thus, data for contaminant concentrations are most appropriately based upon lipid weights of samples when using mussels as bioindicators of aquatic PCB pollution. Considering the kinetic parameters of PCBs based on lipid weight-related data, it is concluded that P. viridis is able to respond rapidly to changes in ambient levels of PCBs. This is significant in determining the usefulness and limitations of mussels as bioindicators for monitoring programs investigating aquatic pollution by PCBs. (Author's abstract)
W88-04128

TWO ENZYME IMMUNOASSAYS TO SCREEN FOR 2,4-DICHLOROPHENOXYACETIC ACID IN WATER,
North Dakota State Univ., Fargo. Dept. of Bio-

chemistry.
J. Fleeker.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 70, No. 5, p 874-878, September/October 1987. 3 fig, 1 tab, 17 ref.

Descriptors: *Pollutant identification, *Immunoassay, *Chemical analysis, *2,4-Dichlorophenoxyacetic acid, *Assay, Bioassay, Enzymes, Herbicides, Groundwater, Municipal water, Rivers, Monitoring, Detection limits.

Two solid-phase enzyme immunoassays were developed to measure 2,4-dichlorophenoxyacetic acid (2,4-D), using two sets of structurally distinct immunogens and enzyme ligands. The 2,4-D analog, 2-methyl-4-chlorophenoxyacetic acid, gave similar responses with both methods, whereas other phenoxy herbicides cross-reacted differently. In method A, the aromatic moiety of 2,4-D was distal from the carrier protein and labeled enzyme, whereas in method B, the acetic acid portion of the herbicide was distal. The use of both methods to screen for this herbicide in groundwater and municipal and river waters reduced the number of false-positive responses. Water sources having a low background response could be monitored with either method alone. When a concentration step, with disposable C18-extraction columns, was used, the limit of sensitivity was 5 micrograms/liter. Method A was the more sensitive of the two methods with a limit of detection of 10 micrograms/liter without the concentration step. (Author's abstract)
W88-04135

ATMOSPHERIC H2O2 MEASUREMENT: COMPARISON OF COLD TRAP METHOD WITH IMPINGER BUBBLING METHOD,
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
H. Sakugawa, and I. R. Kaplan.
Atmospheric Environment ATENBP, Vol. 21, No. 8, p 1791-1798, August 1987. 1 fig, 6 tab, 39 ref. USEPA Agreement CR-807864-02-0.

Descriptors: *Hydrogen peroxide, *Measuring instruments, *Pollutant identification, *Comparison studies, *Cold trap method, *Impinger Bubbling method, Air pollution, Hydrocarbons, Aromatic compounds, Olefins, Organic compounds.

Atmospheric H2O2 was collected by a cold trap method using dry ice-acetone slush as the refrigerant. The air was drawn by a pump into a glass gas trap immersed in the dry ice-acetone slush in a dewar flask at a flow rate of 2.5 liters/minute for 2 hours. Collection efficiency was >99% and negligible interferences by O3, SO2 or organic matter with the collected H2O2 in the trap were observed. This method was compared with the air impinger bubbling method previously described. The measured total peroxide (H2O2 + organic peroxide) values in a series of air samples collected by the impinger bubbling method (0.06 - 3.7 ppb) were always higher than those obtained by the cold trap method (0.02 - 1.2 ppb). Laboratory experiments suggest that the difference in values between the two methods probably results from the aqueous phase generation of H2O2 and organic peroxide in the impinger solution by a reaction of atmospheric O3 with olefinic and aromatic compounds. If these O3-organic compound reactions which occur in the impinger also occur in aqueous droplets in the atmosphere, the process could be very important for aqueous phase generation of H2O2 in clouds and rainwater. (Author's abstract)
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W88-04139

AUTOMATIC RAIN GAUGE FOR CONTINUOUS, REAL TIME DETERMINATION OF RAINWATER CHEMISTRY,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 7B.
W88-04141

METALS IN CRAYFISH FROM NEUTRALIZED ACIDIC AND NON-ACIDIC LAKES,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-04147

MEASURING TRI-N-BUTYLTIN IN SALMON BY ATOMIC ABSORPTION: ANALYSIS WITH AND WITHOUT GAS CHROMATOGRAPHY,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
J. W. Short.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 412-416, September 1987. 2 tab, 8 ref.

Descriptors: *Tri-n-butyltin, *Tin, *Pollutant identification, *Gas chromatography, *Salmon, *Chemical analysis, Fish, Measuring instruments, Bioaccumulation, Tissue analysis, Comparison studies, heavy metals.

Two methods of chemical analysis to determine the concentration of tri-n-butyltin (TBT), frequently found as an active ingredient in anti-foulant preparations, are compared; one method is specific for the compound, the other is not. Salmon from a previous study on TBT exposure were selected for analysis. Of these fish, 12 were chinook salmon reared in sea pens treated with TBT anti-foulants, 5 were chinook salmon not exposed to TBT, and 13 were various types of adult salmon of that were advertised as products of aquaculture and were purchased in fish markets in northwestern USA. Hexane extracts of the fish tissue were analyzed by a simple screening method in which total tin content was determined by atomic absorption spectrophotometry and by a more elaborate method employing a gas chromatograph with an atomic absorption spectrophotometer as a detector (GCAA). The GCAA method involves separation of TBT by gas chromatography, reduction of TBT to metallic tin by a hydrogen-rich flame, and atomic absorption spectrophotometric determination of the vaporized tin. All of the salmon reared in TBT-treated pens, but none from the untreated pens, contained readily detectable concentrations of TBT in muscle tissues; the screening method identified all 12 salmon that contained TBT as determined by the GCAA method. However, the screening method had a tendency to overestimate TBT concentrations in salmon flesh as compared with concentrations obtained by the GCAA method making the screening method most appropriate for identifying biological samples for more critical analysis for TBT. (Wood-PTT)
W88-04149

IDENTIFICATION OF OIL SPILLS IN HARBOURS BY MEANS OF PATTERN RECOGNITION,
Katholieke Univ. Nijmegen (Netherlands). Inst. for Theoretical Physics.
For primary bibliographic entry see Field 5B.
W88-04164

X-RAY FLUORESCENCE DETERMINATION OF PRE-EXTRACTED ALUMINIUM AND GALLIUM IN WASTE-WATERS,
Kazakhskii Gosudarstvennyi Univ., Alma-Ata (USSR). Faculty of Chemistry.
A. I. Zebreva, L. M. Philippova, N. N. Andreeva, and N. V. Ivanova.
Analytica Chimica Acta ACACAM, Vol. 195, p 357-361, April 15, 1987. 3 fig, 3 tab, 7 ref.

Descriptors: *Pollutant identification, *Aluminum, *Gallium, *X-ray fluorescence, *Fatty acids, Wastewater, Extraction procedures, Hydrogen ion concentration, Metal extraction, Phosphorus compounds, Chemical analysis.

The extraction of aluminum and gallium into a molten commercial C17-C20 fatty acid mixture without and with addition of di-2-ethoxyhexylphosphoric acid (DEHP) is described. The effects of temperature, anionic composition of the aqueous phase, concentrations of metals and reagents, phase contact times and phase volume ratios were examined. Almost quantitative extraction is achieved within 3 minutes at about pH 1 with 0.15-0.6 mol/liter DEHP in the fatty acid mixture for organic/aqueous phase ratios of 1:5-1:100. The use of the DEHP mixture provided more distinct phase separation and prevented any hydrolysis of the metal ions. The solidified melts had smooth surfaces and are, therefore, suitable for x-ray fluorescence spectrophotometry. The method allows selective measurement of aluminum and gallium in the presence of iron, titanium, lead, bismuth, scandium and lanthanides which are partly extracted into the melt; copper, zinc, cadmium, calcium, magnesium, strontium and beryllium were not extracted under the above conditions. The method is appropriate for wastewaters. (Wood-PTT)
W88-04165

EFFECT OF CHEMICAL COMPOSITION OF WATER ON HENRY'S LAW CONSTANT,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. Yurteri, D. F. Ryan, J. J. Callow, and M. D. Gurol.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 950-956, November 1987. 2 fig, 8 tab, 21 ref. EPA Contract No. R-811128-01.

Descriptors: *Henry's Law, *Chemical analysis, *Pollutant identification, Organic compounds, Toluene, Trichloroethylene, Humic matter.

The effect of water composition on the measured Henry's Law constant, H, of trichloroethylene and toluene was studied in detail. With this mention, H values determined in synthetic solutions were compared using experimental design techniques. The main factors subject to statistical treatment were: concentration of the organic solute; ionic strength; presence of surfactants; presence of humic material. Additional experiments in pure and natural water samples were carried out to explain the observed effects. H constants for 13 other organic pollutants (such as methylene chloride, carbon tetrachloride, benzene, toluene, etc.) were also measured in distilled and deionized water at 20 C, and compared with predicted and previously reported values. For all H measurements, the principles of the Equilibrium Partitioning In Closed Systems method were implemented with either gas or liquid chromatography analyses. The results confirm that the EPICS method can be used for the reliable H values in both clean and polluted waters. (Lantz-PTT)
W88-04197

LEACHING OF TOXIC METALS FROM INCINERATOR ASHES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. W. Francis, and G. H. White.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 979-986, November 1987. 2 fig, 5 tab, 14 ref. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Pollutant identification, *Toxic metals, *Leaching, *Incineration, Chemical analysis, Leachates, Metals, Water quality.

Composited ash samples from four operating municipal waste incinerators were leached with distilled water and municipal waste leachate to determine the concentrations of toxic metals in the resulting leachates. Concentrations of toxic metals in leachates of resource recovery ashes leached with water were considerably less than those in leachates using municipal waste leachate as the leaching medium. Leachate concentrations were compared to U.S. EPA primary drinking water standards that in some cases were exceeded. Four waste-leaching tests were compared: the California Waste Extraction Test (WET), the EPA Extraction Procedure (EP), extraction of Fluid No. 1 of the recently proposed Toxicity Characteristic Leaching Procedure, and a saturated carbonic acid medium. The WET extracted higher concentrations of toxic metals. (Author's abstract)
W88-04201

MODELING OF MIREX LOADINGS TO THE BOTTOM SEDIMENTS OF LAKE ONTARIO WITHIN THE NIAGARA RIVER PLUME,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W88-04204

DISTRIBUTION AND CHARACTERIZATION OF PCBS IN LAKE MICHIGAN WATER,
Wisconsin Univ.-Madison. Water Chemistry Program.
For primary bibliographic entry see Field 5B.
W88-04205

TRACE CONTAMINANT STATUS OF HAMILTON HARBOUR,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
D. J. Poulton.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 193-201, 1987. 3 fig, 7 tab, 23 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Hamilton Harbor, *Chemical analysis, Heavy metals, Copper, Dissolved oxygen, Iron, Polychlorinated biphenyls, Sediment contamination, Hydrocarbons, Chlorinated compounds, Organic compounds, Niagara River.

Water and sediment samples collected from Hamilton Harbor in 1982 were analyzed for heavy metals and trace organic contaminants to obtain an improved knowledge of the concentrations of these substances and the frequency of violation of guidelines and objectives. In the harbor water, copper exceeded objectives two-thirds of the time, while other metals exceeded objectives less frequently. Higher concentrations were found in the southeast part of the harbor near the major industrial and municipal discharges. As a result of mildly reducing conditions at the sediment-water interface, higher concentrations of manganese were found in bottom waters during late summer; however, input of dissolved oxygen from Lake Ontario prevented highly reducing conditions that would have allowed iron release from the sediments. PCBs and BHCs are found in both the water and sediments, with the distribution of alpha-BHC suggesting that no local source exists for this compound. Loadings of heavy metals and organic compounds from Hamilton Harbor to Lake Ontario are small, compared with either the Niagara River or atmospheric sources. (Author's abstract)
W88-04221

RESTORATION OF HEAVILY POLLUTED BRANCHES OF THE SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
For primary bibliographic entry see Field 5G.
W88-04258

SPECIATION OF ALUMINUM IN AN ACIDIC MOUNTAIN STREAM,
Pittsburgh Univ., PA. Graduate School of Public Health.
J. R. Miller, and J. B. Andelman.
Water Research WATRAG, Vol. 21, No. 8, p 999-1005, August 1987. 6 fig, 4 tab, 25 ref. EPA Contract No. CR-811173.

Descriptors: *Acid rain, *Path of pollutants, *Water chemistry, *Aluminum, *Acidic water, *Speciation, Streams, Pollutant identification, Chemical analysis, Hydrogen ion concentration, Resins, Humic matter.

Using a chelating resin a practical method was developed for speciating aluminum in those oligotrophic streams impacted by acid rain. The four categories operationally defined were rapidly exchangeable (monomeric and small polymeric cationically charged species), moderately fast exchangeable (principally inorganically complexed species), slowly exchangeable (principally organically complexed species), and nonexchangeable or inert aluminum (strong alumino-organic complexes, colloidal, or crystalline forms). Applying the procedure to unfiltered samples collected from a mildly acidic mountain stream, it was found that in upstream samples, where pH was low, rapidly exchangeable aluminum species dominated, while in the downstream samples, where pH was higher, the moderately fast exchangeable, slowly exchangeable, and inert aluminum species were the major ones. Two principal forms of particulate aluminum were also identified and determined: that which dissolves and is taken up by the resin (principally inorganic) and that which remains relatively inert (principally associated with humic material and/or other organic matter). (Author's abstract)
W88-04264

DESIGN OF AN INDEX OF WATER QUALITY,
Auburn Univ., AL. Dept. of Accounting and Finance.
For primary bibliographic entry see Field 5G.
W88-04284

ION-CHROMATOGRAPHY IN THE ROUTINE ANALYSIS OF WATER AND ENVIRONMENTAL MATERIAL (DIE IONEN-CHROMATOGRAPHIE IN DER ROUTINEMAESSIGEN WASSER- UND UMWELTANALYTIK),
Labor fuer Geoanalytik, Hildesheim (Germany, F.R.).
B. Roessner, J. Behnert, and A. Kipplinger.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 327, No. 7, p 698-700, July 1987. 5 fig, 2 tab, 6 ref.

Descriptors: *Analytical methods, *Chlorides, *Chromatography, *Pollutant identifications, *Anions, *Surface waters, *Wastewater analysis, Chemical analysis, Chlorine, Sulfur, Boron, Fluorides, Silicates, Plants, Foods.

Single Column Ion Chromatography (SCIC) using conductivity detection without a suppressor column is introduced. Separations are described for samples with a greater than 1000-fold difference in the anion concentration. A combination of Schoeninger's hydrolyzing process and SCIC is also described. On the basis of numerous investigations of surface waters from the Soesetalsperre region, good reproducibility and comparability could be shown for the values obtained via this method as compared to, ion-sensitive electrodes and ion chromatography with suppressor. The method is safer for the determination of total chlorine and sulfur content of heating oil after combustion in Schoeninger or Wickbold devices. The method is also usable in anion analysis of plants and foodstuffs. Finally, the determination of weakly dissociated ions (e.g. borate, fluoride, silicate) is described. (Airone-PTT)
W88-04323

DETERMINATION OF N-PESTICIDES IN NATURAL WATERS,
ESWE-Inst. fuer Wasserforschung und Wassertechnologie G.m.b.H., Weisbaden (Germany, F.R.).
U. Oehmichen, F. Karrenbrock, and K. Haberer.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 327, No. 7, p 715-719, July 1987. 2 fig, 7 tab, 17 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Chromatography, *Drinking water, *Pesticides, Gas chromatography, Nitrogen compounds, Detection limits, Reproducibility, Preconcentration, Regulations.

Using RP-C18 material in cartridges to preconcentrate natural water samples, a number of important GC-detectable nitrogen containing pesticides can be analyzed. For the 8 pesticides investigated, this method produces high and consistent preconcentration ratios over the entire extraction range (50 to 5000 ng/l) of these compounds. Acceptable repoducibility is achieved for preconcentration of compounds from water samples with both low and high organic loads. The use of HPLC with diode-array detection proved to be less useful for natural water samples than GC. Preconcentration should be a first step in simple monitoring of these water constituents, especially since routine surveys may be required in the near future. (Airone-PTT)
W88-04324

EXPERIMENTAL INVESTIGATIONS ON THE THIN-LAYER CHROMATOGRAPHIC DETERMINATION OF METHOXYCHLOR IN WATERS (EXPERIMENTELLE UNTERSUCHUNGEN ZUR DUENNSCHICHT-CHROMATOGRAPHISCHEN BESTIMMUNG VON METHOXYCHLOR IN WAESSERN),
H. Thielemann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 327, Vol. 7, p 720-721, July 1987.

Descriptors: *Thin layer chromatography, *Insecticides, *Methoxychlor, *Analytical methods, *Pollutant identification, Separation techniques, Water analysis, Wastewater analysis, Agricultural chemicals, Agriculture, Chemical analysis.

Thin layer chromatographic analysis of water samples for Methoxychlor content can be performed according to the experimental protocol described here. Visualization is achieved via silver nitrate and UV irradiation. Pretreatment of the sample by column chromatography may be necessary to remove interfering species (dyes, oils, etc). A specific procedure for distinguishing between Methoxychlor and Dicofolin, is included. Qualitative, semi-quantitative, and quantitative determination of Methoxychlor is described. (Airone-PTT)
W88-04325

DAILY INTAKE OF U-234, -235, -238, TH-228, -230, -232, AND RA-226, -228 BY NEW YORK CITY RESIDENTS,
Department of Energy, New York. Environmental Measurements Lab.
For primary bibliographic entry see Field 5B.
W88-04326

NONDESTRUCTIVE DETERMINATION OF SELECTED U- AND TH-SERIES RADIONUCLIDES IN BIOLOGICAL SAMPLES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
S. R. Joshi.
Health Physics HLTPAO, Vol. 53, No. 4, p 417-420, October 1987. 1 fig, 1 tab, 11 ref.

Descriptors: *Pollutant identification, *Analytical methods, *Emission pectroscopy, *Uranium radioisotopes, *Thorium radio isotopes, Gamma radiation, Radioisotopes, Pike, Fish, Bioaccumulation, Foods, Food chains, Aquatic environment.

Establishing the levels of U- or Th-series radionuclides in fish is a common form of study which aims at deriving the radiation dose received by fish or by humans consuming contaminated fish, or at understanding the role of fish in the biogeochemical cycling of radionuclides. Generally these measurements are carried out using wet chemical methods which require much time, expensive chemicals and highly skilled staff, and which may compromise laboratory safety guidelines. Since the decay of several important U- and Th-series radionuclides or of their short-lived daughters is accompanied by the emission of characteristic gamma rays, the measurement of such emissions with a Ge planar detector constitutes an independent, nondestructive approach to the assay of several such radionuclides in biomaterials and is the subject of this communication. The minimum detectable activity (MDA) values which are obtainable with our detector system generally vary between about 5 and 10 mBq/g dry mass for a 250 000 s count on a 15-g sample. MDA values vary significantly with the radionuclide and the sample type. Standard methods still must remain the choice in cases where maximum sensitivity is required, although for many situations involving concentrations and sample sizes suitable for low-energy photon analysis, the described technique offers a very attractive alternative. (Airone-PTT)
W88-04328

ANALYSIS OF NITRATE IN ENVIRONMENTAL SAMPLES BY REVERSED-PHASE HPLC,

Emporia State Univ., KS. Dept. of Chemistry.
D. C. Schroeder.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 9, p 405-408, September 1987. 2 fig, 4 tab, 7 ref.

Descriptors: *Chromatography, *Nitrates, *Analytical methods, *Water analysis, Wastewater analysis, Chemical interference, Eutrophic lakes, Organic compounds, Detection limits, Nitrite, Chromium, Sulfates, Sulfonates, Phenol, Chemical analysis, High performance, Liquid chromatography.

A method is presented for the analysis of nitrate in natural waters and wastewater by high-performance liquid chromatography (HPLC) with a reversed-phase octadecyl column, aqueous phosphoric acid/dihydrogen phosphate mobile phase, and UV detector. The optimum nitrate concentration is 0.3 to 3 mg/l as N with linear detector response below 3 mg/l. The detection limit is 0.007 mg/l. Relative standard deviations in the optimum range are consistently less than one percent. Several potential interferences have been investigated; nitrite and organic chromophores are resolved from nitrate and do not interfere. Hexavalent chromium and sulfate are slight positive interferences, negligible at typical environmental concentrations. The method produces results in agreement with the accepted chromotropic acid method except in samples from eutrophic lakes, for which evidence is presented indicating that the chromotropic acid is inaccurate. (Author's abstract)
W88-04331

DETERMINATION OF TRACE METALS IN NATURAL WATERS AT NANOGRAM PER LITER LEVELS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY AFTER EXTRACTION WITH SODIUM DIETHYLDITHIOCARBAMATE,
Jadavpur Univ., Calcutta (India). Dept. of Chemistry.
D. Chakraborti, F. Adams, W. Van Mol, and K. J. Irgolic.
Analytica Chimica Acta ACACAM, Vol. 196, p 23-31, May 15, 1987. 1 fig, 4 tab, 23 ref.

Descriptors: *Pollutant identification, *Atomic absorption spectroscopy, *Analytical methods, *Trace metals, *Chemical analysis, Separation techniques, Seawater, Water analysis, Heavy metals, Chelating agents, Lakes, Rivers, Chemical interference, Detection limits, Cadmium, Cobalt, Copper, Iron, Nickel, Lead.

The determination of trace metals (Cd, Co, Cu, Fe, Ni and Pb) at concentrations found in fresh and sea waters is described. The metals are extracted as diethyldithiocarbamates from 500 ml samples into carbon tetrachloride; the extracts are evaporated to dryness and the residues are mineralized with 0.1 ml of concentrated nitric acid. This solution is used for graphite-furnace atomic absorption spectrometry after appropriate dilution. The detection limits are 10 pg Cd, 150 pg Co, 125 p Cu, 100 pg Fe, 250 pg Ni, and 100 pg Pb. The extraction/mineralization method is almost free from interferences, e.g., from trace elements at 500-fold and Na, K, Ca, and Mg at million-fold amounts. The procedure is successfully applied to the determination of the above metals in deionized water, and in river and sea waters. The recommended procedure avoids the slow and difficult back-extraction step with aqueous nitric acid which is sometimes necessary to prevent loss of volatilized metal complexes during ashing and drying. (Airone-PTT)
W88-04332

SENSITIVE DETERMINATION OF TRACES OF BORON IN WATERS, FERTILIZERS, AND GEOLOGICAL AND BIOLOGIAL MATERIALS BY ISOTOPE-DILUTION MASS SPECTROMETRY,
Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements.
N. L. Duchateau, A. Verbruggen, F. Hendrickx, and P. De Bievre.
Analytica Chimica Acta ACACAM, Vol. 196, p 41-47, May 15, 1987. 2 fig, 3 tab, 13 ref.

Descriptors: *Pollutant identification, *Boron, *Mass spectrometry, *Analytical methods, Precision, Trace levels, Water analysis, Chemical analysis, Fertilizers, Bioaccumulation, Geochemistry.

A method is described for determining traces of boron in water, fertilizers, geological and biological (reference) materials by isotope-dilution mass spectrometry after separation on an Amberlite IRA-743 borate-selective ion-exchange column. Boron (5-250 ng/g) in water can be determined with an accuracy of 5-20% (computed on a 2s basis). After correction for weighing errors and for moisture content, which varied from 0 to 8% for the samples tested, 1-35 micrograms/gm boron in 'dry' fertilizer, biological or geological sample can be assayed with an accuracy of 5-30% (2s). In an International Atomic Energy Agency interlaboratory program on a simulated fresh water sample, the method yielded a value of 24.3 + or - 2 micrograms/l, compared to the make-up value of 25 micrograms/l. (Author's abstract)
W88-04333

FLOW-INJECTION METHOD FOR THE DETERMINATION OF TRACE AMOUNTS OF CHLORIDE (ENTWICKLUNG EINER FLIESSINJEKTIONSMETHODE ZUR BESTIMMUNG VON CHLORID IM SPURENBEREICH DURCH LEITFAEHIGKEITSDIFFERENZEN),
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie.
For primary bibliographic entry see Field 7B.
W88-04334

SPECTROPHOTOMETRIC DETERMINATION OF ZINC IN COOKING SALTS, TAP AND MINERAL WATERS WITH PHENYLGLYOXAL MONO(2-PYRIDYL)HYDRAZONE,
Seville Univ. (Spain). Dept. of Bromatology, Toxicology and Applied Chemical Analysis.
A. G. Asuero, M. L. Marques, and M. A. Herrador.
Analytica Chimica Acta ACACAM, Vol. 196, p 311-316, May 15 1987. 1 fig, 4 tab, 18 ref.

Descriptors: *Zinc, *Chelating agents, *Spectrophotometry, *Analytical methods, *Drinking water, *Mineral water, Chemical analysis, Heavy metals, Salts.

The behavior of phenylglyoxal mono(2-pyridyl)hydrazone (PGMPH) with various metal ions was studied by spectrophotometry. The reaction of zinc with PGMPH provides a sensitive and precise method for the determination of zinc in tap and mineral waters and in cooking salts. Zinc ion reacts with PGMPH at pH 7.2-8.5 in solutions containing 40% (v/v ethanol to form a yellow-orange complex with maximum absorbance at 464-47 nm. The molar absorptivity of the 1:2 Zn-PGMPH complex is 71 300 liters per mole per centimeter. Virtually all the pyridyl reagents propsed for zinc, including the present method, are subject to interferences notably from cadmium, iron, cobalt, nickel and copper. Isolation of the zinc or marking of foreign ions is therefore required. (Airone-PTT)
W88-04335

COMPARISON OF TWO CHELATING AGENTS IMMOBILIZED ON CONTROLLED-PORE GLASS FOR THE PRECONCENTRATION OF ALUMINIUM FROM AQUEOUS SOLUTIONS,
Portsmouth Polytechnic (England). Dept. of Chemistry.
E. A. Allen, M. C. Boardman, and B. A. Plunkett.
Analytica Chimica Acta ACACAM, Vol. 196, p 323-327, May 15, 1987. 1 fig, 1 tab, 14 ref.

Descriptors: *Pollutant identification, *Aluminum, *Analytical methods, *Preconcentration, *Chelating agents, *Chemical analysis, Separation techniques, Atomic absorption spectroscopy, Water analysis, Soil chemistry, Trace metals.

Aluminum at low microgram/cu cm levels can be preconcentrated on columns of 8-quinolinol or EDTA immobilized on controlled-pore glass. Distribution coefficients are ca. 45 and 370 sq cm/gm, respectively, and recoveries of aluminum are > 80% at pH > 4.6 and pH > 4.0, respectively. The eluted aluminum is determined by atomic absorption spectrometry in a nitrous oxide/acetylene flame. The results for controlled-pore glass/8-quinolinol agree well with previously obtained results. Although the extent of extraction is lower than desired, greater bed depths and lower flow rates than were used here (3 cm and 5 cu cm/min, respectively) should achieve complete extraction. A stronger HCl eluent could also improve recoveries. (Airone-PTT)
W88-04336

WATER TREATMENT RELATED CHARACTERIZATION OF THE PHOTOCHEMICAL DEGRADATION PRODUCTS OF AQUATIC HUMIC SUBSTANCES (AUFBEREITUNGSORIENTIERTE ASPEKTE DES PHOTOCHEMISCHEN ABBAUS AQUATISCHER HUMINSTOFFE),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 5F.
W88-04341

DETERMINATION OF ORGANIC GROUP PARAMETERS: AOCL, AOBR, AOS IN WATER BY MEANS OF ION-CHROMATOGRAPHIC DETECTION. ENRICHMENT OF MODEL SUBSTANCES AND ELIMINATION OF THE INORGANIC ANION ADSORPTION (BESTIMMUNG DER ORGANISCHEN GRUPPENPARAMETER AOCL, AOBR, AOS IN WAESSERN MIT IONENCHROMATOGRAPHISCHER DETEKTION. ADSORPTION ORGANISCHER MODELLSUBSTANZEN UND VERDRAENGUNG ANORGANISCHER ANIONEN AUF CHLOR- UND SCHWEFELFREIER AKTIVKOHLE),
Gesamthochschule Paderborn (Germany, F.R.). Dept. of Applied Chemistry.
G. Brandt, and A. Kettrup.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 133-138, August 1987. 12 fig, 3 tab, 19 ref.

Descriptors: *Halides, *Pollutant identification, *Chromatography, *Sulfur, *Chlorine, *Bromine, *Water quality, *Enrichment, *Analytical methods, Chlorinated hydrocarbons, Chloroform, Active charcoal, Adsorption, Ionic interference, Anions, Drinking water, Surface water, Chlorides, Sulfates.

Organohalides are a group of compounds of considerable interest in the field of water research because they are generally suspected of causing adverse health effects. The analysis of organohalides in water as a group parameter, e.g. 'adsorbable organic halides AOX' recognizes that many such compounds are not accounted for by methods designed to identify individual compounds. The differentiation of the group parameter AOX and the determination of the parameter 'adsorbable organic sulfur compounds AOS' can be performed using ion-chromatography for detection of the anions, obtained after pyrohydrolysis of the organic adsorbed compounds. Investigations of enrichment of organic solutes on a nearly chlorine- and sulfur-free active charcoal have been performed. To avoid adsorption of interfering inorganic anions, experiments for reduction of these interferences have been carried out. (Author's abstract)
W88-04343

INVESTIGATIONS ON SPECTRAL INTERFERENCES IN ICP-AES (UNTERSUCHUNGEN UEBER SPEKTRALE INTERFERENZEN IN DER ICP-AES),
W. Jaeger, and I. Horn.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 138-141, August 1987. 2 fig, 2 tab, 6 ref.

Descriptors: Measuring instruments, *Pollutant identification, *Spectroscopy, *Metals, *Analytical methods, Aluminum, Tin, Chemical analysis, Detection limits, Wastewater, Drinking water, Water quality, Environmental quality, Soil analysis, Water analysis, Metals.

Water, wastewater, sludge and soil analysis for metals is of great importance in environmental analysis. ICP-AES (inductively coupled plasma-atomic emission spectroscopy) is known as a precise, fast and cost-effective method for this purpose. There is, however, the problem of spectral interferences, which is the subject of this study using the ICP Plasma Spec 2.5. thirty-five elements were investigated and in 19 cases interferences were observed. Two particularly interesting examples involved the metals aluminum and tin for which no interference-free spectral lines could be found. For the group of hydride forming elements (Hg, As, Se, Sb, Bi) the combination ICP-Plasma-Spec 2.5 plus MHH-S was used to check on interferences and detection limits. In the case of these elements, only a (completely unsatisfactory) detection limit of only 0.1 ppm could generally be achieved. In contrast, the AAS-Hydride technique permits detection of 0.0001 to 0.001 ppm without problems. The determination of tin with ICP-AES measurement is not possible due to interference from other emission lines. (Airone-PTT)
W88-04344

ADSORBABLE ORGANIC HALOGEN (AOX) CONTENTS IN FLOWING WATERS OF THE FEDERAL REPUBLIC OF GERMANY (AOX-GEHALTE IN FLIESSGEWAESSERN DER BUNDESREPUBLIK DEUTSCHLAND),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W88-04345

CHLORINATED BENZENES IN THE MIDDLE RHINE - TO THE PROBLEM OF SETTING UP A BALANCE (CHLORIERTE BENZOLE IM MITTELRHEIN - ZUM PROBLEM EINER BILANZIERUNG),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
R. Petersen.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 43-48, July 1987. 11 fig, 8 tab, 7 ref.

Descriptors: *Aromatic hydrocarbons, *Regulations, *Chlorinated hydrocarbons, *Pollution load, Rivers, River systems, Water quality, Environmental protection, Error analysis, Rhine River.

Within the scope of the European Community's Water Protection Guidelines No. 76/464/EWG, emmission 'threshold values' are currently being established for specific substituted aromatic hydrocarbons. these limits are based on production rates, with a loss of 1-2%. The measurement results presented here represent a small portion of the total available material gained in the years 1985/86, and correspond in their order of magnitude to those found by other analysts. Nevertheless, a detailed analytical treatment suggests that there is error potential reflected in the results as a + or - 50% error. Even at twice the obtained values, the concentrations of individual compounds in the Middle Rhine usually remain under 1 microgram/l. However, longitudinal river profiles in certain reaches of the Rhine, the Elbe and the Main have indicate concentrations in excess of 1 microgram/l. For all compounds the increase in concentrations in suspended solids and sediments. (Airone-PTT)
W88-04346

OPTIMIZATION OF REGIONAL WATER QUALITY MONITORING STRATEGIES,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 5G.
W88-04357

ROLE AND PROBLEMS OF MONITORING BOTTOM SEDIMENT FOR POLLUTION ASSESSMENT IN THE COASTAL MARINE ENVIRONMENT,
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
P. Literathy, L. N. Ali, M. A. Zarba, and M. A. Ali.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 781-792, 1987. 4 fig, 4 tab, 20 ref.

Descriptors: *Monitoring, *Water pollution effects, *Bottom sediments, *Coastal waters, *Marine environment, Marine sediments, Fate of pollutants, Pollutant identification, Phosphates, Heavy metals.

The role of bottom sediment in pollution assessment of surface water and the problems related to its characterization were reviewed and identified. The importance of data validation in monitoring bottom sediment was recognized. The effect of grain size distribution and of spatial variations in the bottom sediment justified a sound sampling and analytical protocol. Analyzing the clay-silt fraction to reduce the effect of grain size was reliable. Before monitoring, however, one should prove that bottom sediment characteristics are homogeneous horizontally around the sampling site. Due to vertical sediment stratification from temporal variation of pollution, identification of the sediment layer to be monitored is important. It was found that 'double sampling', i.e., simultaneous sampling of the surface and the top 1 cm of the sediment layer provided representative data when redistribution of the bottom sediment is within acceptable limits. When characterizing the release of carbonate-bound phosphates and heavy metals from sediments, the multistage extraction technique with carbon dioxide was effective. It is concluded that pollutant dynamics and the impact of the intertidal zones on the coastal marine ecosystem could be evaluated by monitoring the sediment, interstitial water, tidal creek and tidal waters simultaneously. (Author's abstract)
W88-04362

AUTOMATIC DETECTION OF COLIFORM BACTERIA FOR INDUSTRIAL CONTROL OF DRINKING WATER QUALITY,
Societe Generale pour l'Agriculture, Rueil-Malmaison (France).
For primary bibliographic entry see Field 7B.
W88-04448

NORTH AND SOUTH AMERICAN STUDIES ON THE POTENTIAL OF COLIPHAGE AS A WATER QUALITY INDICATOR,
National Water Research Inst., Burlington (Ontario).
B. J. Dutka, A. El-Shaarawi, M. T. Martins, and P. S. Sanchez.
Water Research WATRAG, Vol. 21, No. 9, p 1127-1134, September, 1987. 5 fig, 5 tab, 27 ref.

Descriptors: *Bioindicators, *Viruses, *Coliforms, *Bacteriophage, *Water quality control, Water pollution, Seawater, Lakes, Rivers, Stream pollution, Water quality, Streptococcus, Escherichia coli, Path of pollutants, Microbiological studies.

Studies were undertaken to assess the potential of coliphages to be used universally as water quality indicators and more specifically as health hazard indicators. Data were obtained from three water bodies, a northern Canadian river (Ottawa River), inshore water samples from Lake Ontario and from marine beaches in Brazil. Data indicated that within location fecal coliform and coliphages are positively correlated. Coliphage values can be predicted by using fecal coliforms MPN, fecal streptococci MF and E. coli MF data. A water quality guideline of 20 coliphage/100 ml for recreational fresh waters is proposed. (Author's abstract)
W88-04452

THIOSULFATE-DECHLORINATION INTERFERENCE WITH THE FOLIN-CIOCALTEU REAGENT METHOD FOR PROTEIN DETERMINATION,
Johns Hopkins Univ., Baltimore, MD. Div. of Environmental Health Engineering.
For primary bibliographic entry see Field 5F.
W88-04454

5B. Sources Of Pollution

BEHAVIOR OF SOLUBLE SALT IN SHARKEY CLAY-II,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 3C.
W88-03500

ALGAL GROWTH POTENTIALS AND HEAVY METAL CONCENTRATIONS OF THE PRIMARY STREAMS TO UPPER BEAVER LAKE,
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
R. L. Meyer, W. R. Green, K. F. Steele, and D. Wickliff.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149324/AS. Price codes: A06 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 122, June 1986. 94 p, 28 fig, 18 tab, 24 ref, append. Contract No. 14-08-0001-G1004. Project No. USGS G1004-02.

Descriptors: *Nutrients, *Heavy metals, *Toxicity, *Water pollution effects, *Arkansas, Toxic wastes, Path of pollutants.

Algal growth potential was inhibited by heavy metals in upper Beaver Lake, Arkansas. Upper Beaver Lake receives water from three tributaries. One contains a small reservoir and the combined streams receive sewage input. Collections were made approximately monthly at eight sites for the Algal Assay Bottle Test (AABT) and heavy metal analysis. In general, AABT results indicated that the collections above the sewage input were phosphorus limited while those below were nitrogen or combined nitrogen and phosphorus limited. Growth inhibition occurred during summer and early fall at various sites with greater inhibition at the confluence of the streams. No inhibitions occurred at the site below the sewage input. Heavy metal concentrations had an overall tendency to increase downstream. Values within the small reservoir were 50-100% higher than in the feeder stream. Highest values of Pb were observed below the reservoir. So4, Cl, Mg, Ca, Na and K had high values during low flow in August-October. The low values were independent of high flow. Pb followed an independent pattern. Storm event results showed that the Ca maximum was before the hydrographic peak while Fe, Mn, Pb, Zn, Co, Ni, Cu and Cd attained their maximum just after the peak. Maximum values were 4-10 times background values. Mn, Pb and Fe exceeded EPA recommended standards for drinking water. (USGS)
W88-03502

COOLING WATER POLLUTANTS: BIOACCUMULATION BY CORBICULA,
Oak Ridge National Lab., TN.
N. E. Lee, W. R. Haag, and R. L. Jolley.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 851-870, 6 fig, 3 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Aquatic habitats, *Bioaccumulation, Invertebrates, Clams, Corbicula, Chlorinated hydrocarbons, Organic compounds, Accumulation, Cooling water, Powerplants.

Samples of Corbicula, water, and sediment were collected in discharge areas of coal-fired and nuclear powerplants before and after chlorine exposure. About 50 compounds were qualitatively identified in Corbicula at each chlorinated outfall site, 39% of which were common to two or more sampling sites. Most of the compounds were carbohydrates, fatty acids, and hydrocarbons. Four chlorine compounds were listed. In the control Corbicula samples 94 compounds were identified. Several were halogenated. Phthalates were found

at some sites. Data indicated that Corbicula accumulates toxic materials. However, the premise that chlororganics are accumulated from the chlorinated antifoulants cannot be supported conclusively. (Cassar-PTT)
W88-03510

WASTEWATER INPUTS AND MARINE BIOACCUMULATION OF PRIORITY POLLUTANT ORGANICS OFF SOUTHERN CALIFORNIA,
Dames and Moore Marine Services, Los Angeles, CA.
D. R. Young, R. W. Gossett, R. B. Baird, D. A. Brown, and P. A. Taylor.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 871-884, 1 fig, 5 tab, 18 ref.

Descriptors: *Fate of pollutants, *Wastewater analysis, *Chlorination, *Aquatic habitats, Sediments, Organic compounds, Chlorinated hydrocarbons, Tetrachloroethylene, Seawater, Invertebrates, Marine invertebrates, Fish, Accumulation, Bioaccumulation.

Primary effluents of municipal wastewaters in southern California were sampled during July 1978. About 10% of the 113 priority pollutant trace organics were measured above the 10-ppb level. Since dilution of seawater was at least 100, the final concentration of priority pollutants was estimated at <0.1 ppb. Generally, volatile organics occurred at the highest levels in municipal wastewaters. Nevertheless, the sediments in a highly contaminated outfall zone contained <0.5-ppb wet weight of these compounds. None of the compounds were found in liver tissue of benthic feeding fish above the 20-ppb level. Tetrachloroethylene appeared in several samples at 10-20 ppb. No relationship was observed between the octanol:water partition coefficient and the bioaccumulation index selected (the ratio of average concentrations measured in fish liver and final effluent). (Cassar-PTT)
W88-03511

BIOCONCENTRATION OF BROMOFORM BY AMERICAN OYSTERS, CRASSOSTREA VIRGINICA (G.), EXPOSED TO CHLORINATED AND DECHLORINATED SEAWATER, WITH NOTES ON SURVIVAL AND FEEDING,
Research Planning Inst., Inc., Meggett, SC.
For primary bibliographic entry see Field 5C.
W88-03522

CONTAMINATION OF PURIFIED WATER BY MUTAGENIC ELECTROPHILES,
American Univ., Washington, DC. Dept. of Chemistry.
A. M. Cheh, R. E. Carlson, J. R. Hildebrandt, C. Woodward, and M. A. Pereira.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1221-1235, 5 fig, 4 tab, 30 ref.

Descriptors: *Water treatment, *Mutagens, Organic compounds, Distillation, Reverse osmosis, Membrane processes, Activated carbon, Adsorption, Electrophiles, Chlorinated hydrocarbons.

Concentrated drinking water samples from four water purification systems were subjected to the Ames assay for mutagenic activity. XAD resins were used to concentrate electrophilic organic compounds, ranging from trihalomethanes to nonvolatile, unidentified compounds. All distilled waters were contaminated to some extent by electrophile carryover (37-570 revertants/L of water). A single-stage distillation in an electrically heated still nearly doubled the level of mutagenic electrophiles (570 revertants/L) compared with the influent tap water (320 revertants/L). Steam-driven distillation appeared to cause less carryover, reducing influent 502-1014 revertants/L to 37-90 revertants/L. Mutagenic electrophiles were completely removed from a reverse osmosis effluent passed through a carbon filtration-ion exchange system. (Cassar-PTT)
W88-03539

CHLORINE VS OZONE AT MARLBOROUGH, MASSACHUSETTS: DISINFECTION AND MUTAGENIC ACTIVITY SCREENING,
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5D.
W88-03541

CONTRIBUTIONS OF SOME CHLORINATED ALIPHATIC COMPOUNDS TO THE MUTAGENICITY OF SPENT KRAFT PULP CHLORINATION LIQUORS,
Svenska Traeforskningsinstitutet, Stockholm.
K. P. Kringstad, P. O. Ljungquist, F. de Sousa, and L. M. Stromberg.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1311-1323, 5 fig, 2 tab, 17 ref.

Descriptors: *Pollutant identification, *Pulp wastes, *Chlorination, *Wastewater treatment, *Mutagens, Organic compounds, 2-Chloropropenal.

Two spent chlorination liquors from kraft pulp bleaching were analyzed for mutagens using the Ames test, strain TA1535. The compounds 2-chloropropenal and 1,3-dichloroacetone were present at high mutagenic activity. A dose-response curve for 2-chloropropenal showed that this compound is probably responsible for a large part of the mutagenic activity in spent chlorination liquors. A dose of 50 ng/plate yielded about 170 revertants. The dose per plate of this compound when testing spent chlorination liquor is about 20-25 ng, which yields 70-90 revertants. Therefore 2-chloropropenal is responsible for 45-55% of the mutagenicity in the liquors. A dose-response curve for 1,3-dichloroacetone showed that, although it has high mutagenic activity, it does not contribute significantly to mutagenic activity of the effluent because it is present in low concentrations. None of the following appeared to contribute to total mutagenic activity to a significant degree: trichloroethylene, monochloroacetaldehyde, 1,1,3,3-tetrachloroacetone, pentachloroacetone, and hexachloroacetone. (Cassar-PTT)
W88-03544

CHLORINATION OF MUTAGENIC FRACTIONS OF COKE-PLANT EFFLUENTS,
Antwerpse Waterwerken (Belgium).
F. Van Hoof, and G. Manteleers.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1325-1332, 7 fig, 10 ref.

Descriptors: *Water pollution sources, *Chlorination, *Coke plants, *Mutagens, Industrial wastewater, Wastewater analysis, Meuse River, Belgium, Fate of pollutants, Organic compounds, Polyaromatic hydrocarbons, Azaarenes, Pollutant identification.

Mutagens were isolated from coke plant effluents. In the neutral extract polyaromatic hydrocarbons were responsible for mutagenicity. Compounds identified included naphthalene, methylnaphthalene, dimethylnapthalene, biphenyl, biphenylene, methylbiphenyl, acenaphthene, fluorene, anthracene, phenanthrene, and indole. In the basic extract azaarenes were responsible for mutagenicity. Compounds identified in this fraction included quinoline, methylquinoline, triisoamylamine, and some higher molecular weight azaarenes. Chlorination of the mutagenically active fractions removed the mutagenic activity. This evidence suggests that the frameshift promutagens discharged into the River Meuse by coke plants are not the precursors for direct-acting mutagens formed by prechlorination of surface water from the river. (Cassar-PTT)
W88-03545

TRIHALOMETHANE VARIATION IN PUBLIC DRINKING WATER SUPPLIES,
New Jersey Dept. of Environmental Protection, Trenton.
T. A. Burke, J. Amsel, and K. P. Cantor.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1343-1352, 3 fig, 3 tab, 14 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Trihalomethanes, Chloroform, Chlorinated hydrocarbons, Water treatment, Water supply.

Trihalomethanes (THMs) (chloroform, brominated THMs, and total THMs) were determined in raw, treated, and delivered samples of 15 New Jersey water supplies. Ten were derived from surface water, five from groundwater. Systems ranged in size from 1,017 to 750,000 persons served. The water supplies represented sources of varying potential contamination from surface runoff and from wastewater effluents. Total THMs in ppb were as follows: raw water, none detected to 7.6; treated water, none detected to 144.2; and delivered water, 0.60 to 166.5. Except for brominated THMs in delivered water, groundwater supplies had significantly lower levels of THM in treated and delivered samples. Raw water showed no significant difference in THM levels between surface and ground sources. Treated and delivered water from surface supplies showed highest levels of THM in October with progressively lower levels in December and February. Ground supplies showed a similar trend, but the differences were not statistically significant. (Cassar-PTT)
W88-03547

EPIDEMIOLOGIC STUDIES OF CHLORINATION BY-PRODUCTS IN DRINKING WATER: AN OVERVIEW,
National Cancer Inst., Bethesda, MD. Environmental Epidemiology Branch.
For primary bibliographic entry see Field 5C.
W88-03550

HEALTH RISKS OF DRINKING WATER DISINFECTANTS AND DISINFECTION BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W88-03551

WATER CHLORINATION AND FOODS-FDA CONSIDERATIONS AND CONCERNS,
Food and Drug Administration, Rockville, MD.
For primary bibliographic entry see Field 5F.
W88-03555

SURVIVAL OF INDICATOR ORGANISMS IN A DETENTION POND RECEIVING COMBINED SEWER OVERFLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
L. Lijklema, B. Habekotte, C. Hooijmans, R. H. Aalderink, and A. H. Havelaar.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 9-17, 1986. 7 fig, 4 tab, 9 ref.

Descriptors: *Wastewater disposal, *Wastewater treatment, *Fate of pollutants, *Public health, *Microorganisms, Microbiological studies, Bacteria, Bacteriophages, Sewage bacteria, Microorganisms.

The intensity, duration and spatial extent of microbial contamination by Combined Sewer Overflows impairs the beneficial use of the receiving waters. This study examined the removal of four groups of indicator bacteria and two groups of bacteriophages in a detention pond receiving combined sewer overflows, and the survival of the bacteria in the sediments. The overall removal rate of the bacteria tended to be somewhat higher than the removal rate for phages. Most values were in the range of 0.7-1.0 per day (e-basis). Sedimentation was of limited importance except for a short period following the overflow event. Dilution contributed to a reduction of 0.3-0.4 per day and die-off rates were about 0.3-0.6 per day, for phages perhaps as low as 0.2 per day. Survival of the bacteria in the

sediment was much better than in the water, with net loss rates approximately 0.1 per day, resulting in a more or less continuous contamination of the sediment with pathogenic bacteria as represented by indicator organisms. (Authors' abstract)
W88-03560

SURVIVAL AND TRANSPORT OF HEPATITIS A VIRUS IN SOILS, GROUNDWATER AND WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, P. A. Shields, F. H. Hauchman, R. L. Hazard, and L. W. Caton.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 97-106, 1986. 7 tab, 22 ref. EPA grant CR810509.

Descriptors: *Fate of pollutants, *Path of pollutants, *Groundwater, *Wastewater disposal, Microorgansims, Wastewater farming, Viruses, Public health, Enteroviruses, Diseases.

The transport and fate of enteric viruses in groundwater and soils systems is an important public and environmental health consideration in the disposal of wastewater and wastewater sludges on land. Land application of municipal sewage effluents and sludges, leachates from septic tanks, lagoons and landfills, and broken sewer lines pose a risk of viral contamination of the soil and the underlying groundwater. Hepatitis A virus (HAV), poliovirus type 1 and echovirus type 1 were studied for their adsorption and survival in groundwater, wastewater and soils suspended in these media, and for survival and transport through unsaturated miniature soil columns intermittently dosed with virus-laden groundwater or wastewater. There were differences among the viruses in adsorption to soils (poliovirus most, echovirus least). All three viruses survived well (<90% inactivation) for at least 12 weeks in groundwater, wastewater and soil suspensions at 5 C. At 25 C, HAV survived generally longer, with 90-99% inactivation of HAV and 99.9-99.99% inactivation of poliovirus and echovirus in 12 weeks. In miniature soil columns dosed with virus-laden groundwater or wastewater, virus reductions were generally least for echovirus and greatest for poliovirus. The ability of HAV to survive for long periods in soils, groundwater and wastewater and to migrate to some extent through unsaturated soils helps to explain why HAV can contaminate groundwater and cause outbreaks of groundwaterborne disease. (Authors' abstract)
W88-03570

DISINFECTION OF CHLORINE RESISTENT ENTEROVIRUSES IN GROUND WATER BY ULTRAVIOLET IRRADIATION,
Thames Water Authority, London (England).
J. S. Slade, N. R. Harris, and R. G. Chisholm.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 115-123, 1986. 5 tab, 5 ref.

Descriptors: *Groundwater, *Fate of pollutants, *Water treatment, *Enteroviruses, *Disinfection, Chlorination, Ultraviolet radiation, Public health.

The discovery of human enteric viruses in a well which had long yielded water of the highest standard aroused interest which revealed two unusual phenomena. Viruses were consistently present, at low concentrations, in the absence of the normal bacterial indicators of fecal pollution, and the viruses were exceptionally resistant to conventional chlorine disinfection. The human enteroviruses, predominantly poliovirus type 1, survived disinfection at 1.0 mg/liter of free residual chlorine maintained for a minimum contact time of 15 min at pH 7.2 and 11 C. Disinfection with 1.5 mg/liter of chlorine under the same conditions resulted in virus inactivation. The viruses were also destroyed by exposure to 25 mJ/sq cm of ultraviolet light. It appears that the chlorine resistance of these viruses is due to their association with an organic floc rather than to any innate property of the virus or the water. (Authors' abstract)
W88-03572

DRINKING WATER TRANSMISSION OF GIARDIASIS IN THE UNITED STATES,
Health Effects Research Lab., Cincinnati, OH.
E. W. Akin, and W. Jakubowski.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 219-226, 1986. 3 tab, 30 ref.

Descriptors: *Human diseases, *Giardia, Drinking water, Parasites, Protozoans, Pathogens, Public health, Diseases.

Giardia lamblia is recognized as a cause of disease that ranges from mild to severe and debilitating gastroenteritis. Since 1965 drinking water has been implicated as an important route of transmission. An outbreak at a Colorado ski resort caused 123 persons to experience acute enteritis, possibly giardiasis, from suspected sewage contamination of a well water supply. Giardia was first isolated from a water supply implicated in an outbreak in 1975 that resulted in 359 confirmed cases over a 7 month period. Subsequent outbreaks have clearly established the role of water in Giardia transmission. From 1965 to 1984, 90 waterborne outbreaks with 23,776 cases of giardiasis were reported in the United States. Filtration with adequate chemical pretreatment is an important barrier. Adequate disinfection is essential to the prevention of waterborne giardiasis. (Authors' abstract)
W88-03584

ROLE OF ANIMALS IN THE WATERBORNE TRANSMISSION OF VIRUSES,
Southwest Foundation for Biomedical Research, San Antonio, TX.
S. S. Kalter.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 241-263, 1986. 2 tab, 77 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Viruses, *Human diseases, Public health, Diseases, Pathogens, Microorganisms.

Water contamination by human viruses is well established, as is the waterborne transmission of human viruses to the human with resulting disease. Other forms of life also carry viruses of human and non-human origin and these, too, are known to transmit diseases to humans in some instances. What is not well understood and has not been studied is the occurrence in water of viruses derived from sources other than humans. From the available information it would appear that human disease as a result of water transmission of non-human viruses has been inconsequential. This review probes the various sources of non-human viruses and demonstrates the potential for direct and indirect causation of human disease as well as the indirect effect on the human by virtue of possible effects on other animal and plant life. Viruses from non-human sources are described, their recognized infectivity indicated, and an attempt is made to describe the implications of these findings. (Author's abstract)
W88-03587

UNDERGROUND STORAGE TANKS POTENTIAL FOR ECONOMIC DISASTER,
Law Environmental Services, Marietta, GA.
D. L. Russell, and S. W. Hart.
Chemical Engineering CHEEA3, Vol. 94, No. 4, p 61-69, March 1987. 4 fig, 3 tab, 4 ref.

Descriptors: *Environmental policy, *Storage tanks, *Underground storage, *Environmental effects, *Legal aspects, *Legislation, *Liability, *Regulations, *Hazardous materials, *Testing procedures, *Environmental protection, Leakage, Petroleum, Chemicals, Engineering, Environmental quality, Planning, Standards, Construction, Contaminants, Monitoring.

In 1984, Congress amended the Resource Conservation and Recovery Act adding provisions to control the underground storage of hazardous substances along with hazardous wastes. The Amendment also set up requirements for underground-tank monitoring and leak detection, and told EPA to establish financial responsibility standards for tank owners. The final regulations governing underground storage tanks are to be issued in mid-1987. Underground-tank integrity testing, and the use of periodic groundwater monitoring, will be required on all underground-tank systems. A brief overview of the commercially available volumetric-type tank testing systems, and summaries of their limitations are provided. The objectives of an assessment program should be to determine which of the four types of contamination (contaminated soil, free product, dissolved constituents or vapor phase) are present. A corrective-action program should consist of two parts: elimination of the source, and cleanup of contaminants. Eliminating underground storage tanks or installing the necessary containment facilities that are required to prevent the loss of chemicals into the ground should be considered. (Main-PTT)
W88-03610

STORMWATER POLLUTION MODELLING: MINOR SOURCES OF POLLUTANTS IN URBAN SEWER NETWORKS,
P.E.S. Engineering Coll., Mandya (India). Dept. of Civil Engineering.
B. Shivalingaiah, and W. James.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 131-134, 1987. 1 tab, 11 ref.

Descriptors: Descriptors:*Water pollution sources, *Model studies, *Urban runoff, *Sewers, *Air pollution, *Storm water, *Storm runoff, Pollution, Storm-overflow sewers, Canopy washoff, Base flow.

In addition to the well-known, major pollution processes of dry weather buildup and wet weather washoff and routing, some less obvious minor processes contribute background pollutants to urban stormwater. Since related pollutant loads during storm events are not significant, the processes are termed 'minor.' These processes, which appear to be seasonally persistent, include aerosol and gaseous scavenging from the atmosphere, leaf canopy washoff, dry weather base flow, and local deposition/erosion due to obstructions. Equations are presented for each process. Algorithms for these equations were incorperated in version 3 of the U.S. Environmental Protection Agency stormwater management model (SWMM3) and tested collectivley. The modified version is known as CHGQUAL. The effect of variable time steps in the computational scheme is discussed. CHGQUAL evidently contains more process-oriented algorithms and may predict surface water pollution management options better than SWMM3. Until more definite data becomes available, however, CHGQUAL should be used with caution. (Author's abstract)
W88-03645

EFFECTS OF SALINITY AND VARYING BORON CONCENTRATIONS ON BORON UPTAKE AND GROWTH OF WHEAT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W88-03661

EFFECTS OF COLORANTS IN THE AQUATIC ENVIRONMENT,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5C.
W88-03663

BIOCONCENTRATION OF ALCOHOL ETHOXYLATES IN CARP (CYPRINUS CARPIO),
Tokyo Metropolitan Research Inst. for Environmental Protection (Japan).
For primary bibliographic entry see Field 5C.
W88-03664

BIOACCUMULATION IN FOOD CHAINS-A RATIONAL APPROACH,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
F. Moriarty, and C. H. Walker.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 208-215, April 1987. 3 fig, 16 ref.

Descriptors: *Path of pollutants, *Pollutants, *Bioaccumulation, *Food chains, Accumulation, Pollution, Ecosystems, Metabolism, Ecology, Animal size.

How much and how quickly pollutants move along food webs is an important part of predicting ecological effects. Animal size and comparative metabolism are two important aspects that have been highly ignored for the most part. The uptake, metabolism, and excretion of pollutants by individual species are studied. Data were used to predict the behavior of pollutants in individuals, and from these predictions the fate of pollutants in food chains is discussed. The validity of these predictions can be tested experimentally. (Master-PTT)
W88-03668

FATE OF 2,5,4'-TRICHLOROBIPHENYL IN OUTDOOR PONDS AND ITS UPTAKE VIA THE GILLS IN GRASS CARP AND RAINBOW TROUT,
Shell Research Ltd., Sittingbourne (England).
N. O. Crossland, D. Bennett, and C. J. M. Wolff.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 225-238, April 1987. 1 fig, 11 tab, 21 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Polychlorinated biphenyls, *Pollutants, *Bioaccumulation,*Fish toxins, Trout, Rainbow trout, Carp, Grass carp, Fish, Pollution, Food chains, Trichlorobiphenyl, Biodegradation.

A field experiment was carried out to investigate the fate and the extent to which food chain transfer of a PCB congener (2,5,4'-trichlorobiphenyl;3-CB) could affect its potential for bioaccumulation. Three 35-cam ponds were each stocked with 25 rainbow trout (a carnivore) and 20 grass carp (a herbivore). 3-CB was supplied to each pond at a nominal concentration of 14 microgram (ug) liter-1. Samples of water, sediment, grass carp, rainbow trout, aquatic plants, and invertebrates were removed at intervals from 0 to 28 days after treatment and residues of 3-CB were determined using gas-liquid chromotography with electron-capture detection. The fate of 3-CB in the ponds was determined by transport rather than degradation processes. Evaporation accounted for 86-87 percent loss and absorption onto sediment and biota for 11-12 percent loss of 3-CB from the pond water after 28 days. The kinetics of transport between water, air, sediment, and biota were studied after fitting the data to a three-compartment model. This model was used to calculate rates of evaporation K sub e and sorption. The calculated value for K sub e was in good agreement with predictions based on fundamental relationships between Henry's constant, windspeed, and ke. Residues of 3-CB in rainbow trout accumulated to a significantly greater extent ($P < 0.05$) than in grass carp. This difference could not be explained by differencesin growth rates, distribution of lipids, or by a difference in accumulation of 3-CB residues via the food chain. This experimental work supports the conclusion, suggested by a modeling approach of other workers, that food chain accumulation of PCBs can be an important route for uptake when environmental concentrations are quite low. (Author's abstract)
W88-03669

VIRAL ANTIBODIES IN AGRICULTURAL POPULATIONS EXPOSED TO AEROSOLS FORM WASTEWATER IRRIGATION DURING A VIRAL DISEASE OUTBREAK,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal, M. Margalith, H. I. Shuval, Y. Wax, and A. Morag.
American Journal of Epidemiology AJEPAS, Vol. 125, No. 5, May 1987. 2 fig, 5 tab, 12 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Pollutants, *Human diseases, *Wastewater irrigation, Irrigation, Diseases, Viral diseases, Enteroviruses, Hepatitis, Wastewater aerosols, Aerosols.

The presence of antibodies to eight enteroviruses (echovirus typres 4, 7, and 9, coxsackievirus types A9, B1, B3, B4, and hepatitis A virus) and varicel-lazoster virus was determined during a two-year period, 1980-1981, in paired blood samples of 777 persons in selected agricultural communities (kibbutzim) in Israel. These communities were divided into several categories on the basis of waste-water utilization for sprinkler irrigation and/or fish ponds. Among the nine viral antibodies studied, there was a consistent and significant excess of antibodies to echovirus typr 4 only, particularly in the age group 0-5 years, in kibbutzim that had been exposed to aerosols from sprikler irrigation with partially treated wastewater from nearby towns. This finding may be attribute to a major national echovirus type 4 epidemic, which had peaked shortly before the collection of the blood samples. The fact that no similar excess of viral antibodies studied was found in any of the kibbutz categories implies that, under nonepidemic conditions, exposure to wastewater aerosols usually does not lead to an excess in enteroviral infection. No excess of clinical cases of echovirus type 4-associated disease (meningitis or encephalitis) was detected in the communities exposed to wastewate aerosol. (Author's abstract)
W88-03672

THEORY OF SOLUTE TRANSPORT BY GROUNDWATER,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
G. Dagan.
Annual Review of Fluid Mechanics ARVA3, Vol. 19, p 183-215, 1987. 4 fig, 35 ref.

Descriptors: *Mathematical analysis, *Path of pollutants, *Groundwater pollution, *Solute transport, Aquifers, Physico-chemical interactions, Theoretical analysis.

The development of solute transport theory is examined, with field data only briefly mentioned to illustrate salient points. The discussion is limited to the transport of inert solutes at low concentrations, which do not decay or ineract with the solid matrix, nor influence fluid properties. In groundwater applications, the velocity field that is accessible either by direct measurements or by computations is Eulerian, and therefore emphasis is placed on the relationship between transport and the Eulerian velocity field. The relationship between transport and the Eulerian velocity field and the heterogeneous structure is considered in a series of mathematical equations which relate the concentration field to the heterogeneous structure. This can be achieved by deriving the relationship between the velocity field and the formation properties. When the theory was compared with the results of a very elaborate field test of solute transport at the Borden site in Canada, a site in which both hydraulic conductivity and concentration have been mapped extensively in space and time, there satisfactory agreement in view of the various approximations involved in the process. (Ray-PTT)
W88-03685

FATE OF 7,12-DIMETHYLBENZ(A)ANTHRACENE IN RAINBOW TROUT, SALMO GAIRDNERI,
New York Univ. Medical Center, Tuxedo Park. Lab. of Environmental Studies.
A. R. Schnitz, K. S. Squibb, and J. M. O'Connor.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1 p 29-36, July 1987. 3 tab, 9 ref. Grant API-4875 National Institute of Environmental Health Sciences (ES 0026).

Descriptors: *Trout, *Fate of pollutants, *Path of pollutants, *Water pollution effects, *Polycyclic aromatic hydrocarbons, Dimethylbenzanthracene, Fish metabolism, Tissue analysis.

Sexually immature rainbow trout were dosed with 7, 12-dimethylbenz (a) anthracene (DMBA; 655 + or - 8 ng) by gavage under light anesthesia and four fish sacrificed at 6, 12, 24, 48, and 72 hr after dosing. Muscle, gill, gall bladder, liver, stomach, intestine, and trunk kidney were analyzed. DMBA was assimilated from the gut of rainbow trout and transported to tissues rapidly, with the majority of the body burden retained in, or transported to, the hepatobiliary system. These results are consistent with the concept that liver metabolism, transport of parent compound and conjugated metabolites to the gall bladder, and excretion to the intestine, is the primary route for polycyclic hydrocarbon elimination in fishes. (Ray-PTT)
W88-03691

TOTAL AND METHYL-MERCURY CONTENT IN BIVALVES, MYTILUS GALLOPROVINCIALIS LAMARCK AND OSTREA EDULIS LINNAEUS: RELATIONSHIP OF BIOCHEMICAL COMPOSITION AND BODY SIZE,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5C.
W88-03695

LEAD UPTAKE AND LEAD LOSS IN THE FRESH WATER FIELD CRAB, BARYTELPHUSA GUERINI, ON EXPOSURE TO ORGANIC AND INORGANIC LEAD,
Osmania Univ., Hyderabad (India).
For primary bibliographic entry see Field 5A.
W88-03696

SEASONAL VARIATION OF THE CADMIUM CONTENT OF MUREX TRUNCULUS IN A NON-CADMIUM POLLUTED ENVIRONMENT,
Liege Univ. (Belgium).
J. M. Bouquegneau, and M. Martoja.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 67-73, July 1987. 2 fig, 7 ref.

Descriptors: *Path of pollutants, *Cadmium, *Mollusks, *Gastropods, *Bay of Calvi *Seasonal variation, Corsica, Crustaceans, Heavy metals.

Although analyses of waters of the Bay of Calvi in Corsica indicate no cadmium pollution, mollusks from the bay contain significant amounts of cadmium. Investigation of this anomaly showed that the cadmium content of the soft tissues of the mollusks increased from February to July and decreased during the rest of the year. These variations appear not to be related to the sexual cycle. The largest decrease occurs during shell formation. It is concluded that: 1. High loads of cadmium in some species are not necessarily correlated with high levels of pollution of their environment, and 2. When comparing the contamination level of specimens from a single species caught in different areas, the season during which they have been collected should be taken into account. (Ray-PTT)
W88-03697

COLIPHAGES AND BACTERIA IN GROUNDWATER FROM TEHRAN, IRAN,
Tehran Univ. (Iran).
M. Shariatpanahi, and A. C. Anderson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 1, p 92-99, July 1987. 2 tab, 6 ref.

Descriptors: *Bacteria, *Viruses, *Groundwater pollution, *Tehran, *Iran, *Bioindicators, *Path of pollutants, *Coliphages, *Coliforms.

The microbial quality of Tehran's groundwater and selected springs was studied, using coliphages and selected bacteria as indicator organisms. All the sources tested showed microbial/coliphage contamination of water supply. Generally, the number of bacteria and phage positive sites increased paralleling the movement of the groundwater toward to the surface. It is concluded that coliphages are satisafactory indicators of the pollution. (Ray-PTT)
W88-03698

REDUCTIVE METABOLISM OF AMINOAZOBENZENES BY PSEUDOMONAS CEPACIA,
Gifu Univ. (Japan). Dept. of Chemistry.
E. Idaka, T. Ogawa, and H. Horitsu.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 1, p 100-107, July 1987. 5 fig, 1 tab, 5 ref.

Descriptors: *Reductive metabolism, *Aminobenzines, *Biodegradation, *Dyes *Fate of pollutants, Bacteria, Dye industry wastes.

Strain 13NA of Pseudomonas cepacia was isolated from the sewage sludge of an azo dye factory in Japan. Cultures of 13 NA were incubated with 10 ppm of p-aminogobenzene, p-acetimido-azobenzene, 2,4-diaminoazobenzene, and 4, 4-diaminoazobenzene at 37C under static conditions. Thin layer chromatography and high pressure liquid chromatography were used to identifiy the metabolites. The results showed that the aminobenzenes, in addition to being cleaved at the azo-linkage, are acetylated first and the resulting product then undergoes fission at the azo site. (See also W88-03700) (Ray-PTT)
W88-03699

TRICLOPYR PERSISTENCE IN WESTERN OREGON MILL PASTURES,
Oregon State Univ., Corvallis. Dept. of Forest Science.
L. A. Norris, M. L. Montgomery, and L. E. Warren.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 1, p 134-141, July 1987. 2 fig, 10 ref. USDA Forest Service Grants PNW-126 and PNW-248.

Descriptors: *Triclopyr, *Herbicides, *Environmental risk assessment, *Fate of pollutants, *Path of pollutants, Oregon, Strain pollution, Leaching, Overland flow.

Triclopyr effectively controls many woody plants and is increasingly important for vegetation management. The movement and persistence of triclopyr and its principal metabolities was determined in grass, soil, and water to provide a better basis for evaluating environmental risks associated with using this herbicide in western Oregon. Even though present in the soil, triclopyr was not detected in stream water during subsequent periods of base (low) flow. It appears that neither long distance overland flow nor leaching introduced significant amounts of trichopyr to the stream at the monitoring site. It is concluded that the use of triclopyr in western Oregon, according to the label, offers little opportunity for toxicologically significant exposure to non-target organisms or downstream water users. (Ray-PTT)
W88-03701

OXYGEN DEPLETION MODELLING, PORT SHELTER, HONG KONG,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
J. Krogsgaard-Jensen, A. Malmgren-Hansen, and P. Mortensen.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 277-287, 1986. 4 fig, 3 tab, 4 ref.

Descriptors: Descriptors:*Model studies, *Path of pollutants, *Water pollution effects, *Wastewater treatment, *Biological oxygen demand, Mathematical models, Organic matter, Sediment, Municipal wastewater.

A relatively simple BOD-DO-box model was established to describe and evaluate the effect on the oxygen concentrations of a planned sewage outlet in the Port Shelter Bay in Hong Kong. The model describes the oxygen concentration in 6 horizontal boxes in the central part of Port Shelter. Each box is vertically divided into 4 layers (sub-boxes). The oxygen concentration in each layer is described as a function of the vertical and the horizontal mixing, the oxygen demand of the sediment, and the concentration of organic matter in the water. A finite difference transport dispersion model provided input data for the BOD-DO model. (Authors' abstract)
W88-03733

SOIL GAS CONTAMINANT INVESTIGATIONS: A DYNAMIC APPROACH,
Tracer Research Corp., Tucson, AZ.
For primary bibliographic entry see Field 7B.
W88-03760

OBSERVATION OF DELIVERY AND SIMPLE QUALITY PARAMETERS ON SPRINGS OF THE FIRST VIENNA ELEVATED-SOURCE WATER SUPPLY,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
For primary bibliographic entry see Field 5F.
W88-03761

RECENT DEVELOPMENTS IN DRINKING-WATER SUPPLY FROM THE INTERNATIONAL RIVERS RHINE AND MEUSE IN THE NETHERLANDS,
Biesbosch Water Storage Corp. (Netherlands).
For primary bibliographic entry see Field 5F.
W88-03764

AQUAMOD: A Z-DIMENSIONAL GALERKIN FINITE-ELEMENT SIMULATION PROGRAM FOR MICROCOMPUTERS FOR PREDICTION OF POLLUTANT TRANSPORT IN SATURATED GROUNDWATER FLOW (AQUAMOD: 'N TWEE-DIMENSIONELE GALERKIN EINDIGE ELEMENT SIMULASIEPROGRAM VIR MIKROEKENAARS VIR DIE VOORSPELLING VAN VERSADIGDE GRONDWATERVLOEI EN BESOEDELING),
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
For primary bibliographic entry see Field 2F.
W88-03773

HYDROCARBON LEVELS IN THE SWARTKOPS ESTUARY: A PRELIMINARY STUDY,
Port Elizabeth Univ. (South Africa). Dept. of Botany.
T. Hilmer, and G. C. Bate.
Water S. A. WASADV, Vol. 13, No. 3, p 181-184, July 1987. 3 fig, 14 ref.

Descriptors: *Swartkops Estuary, *Water pollution sources, *Runoff, *Estuaries, *Hydrocarbons, *Rainfall, *South Africa, Oil.

Above-background hydrocarbon levels were measured in five out of six stations on the Swartkops estuary. Post-rainfall hydrocarbon levels were higher than pre-rainfall levels, and were more likely of terrestrial origin than of sea-borne origin from Algoa Bay. Common oil products such as car and diesel pump oil, outboard engine oil and crude oil were not directly incriminated as the sources, but 'runoff' containing coal dust may have been responsible in one sample. (Author's abstract)
W88-03774

ANALYSIS OF EMISSION DATABASES FOR REGIONAL MODELS,
National Center for Atmospheric Research, Boulder, CO. Acid Deposition Modeling Project.
For primary bibliographic entry see Field 7C.
W88-03777

MODELING VOLATILE ORGANICS IN THE DELAWARE ESTUARY,
Environmental Research Lab., Athens, GA.
R. B. Ambrose.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 703-721, August 1987. 8 fig, 5 tab, 27 ref, append.

Descriptors: *Path of pollutants, *Model studies, *Delaware estuary, *Volatile organic compounds, *Estuaries, TOXIWASP, DYNHYD, Effluents, Treatment facilities, Simulation, Hydrodynamics, Organic compounds, Prediction, Kinetics.

A study was conducted to test whether calibrated tidal transport models linked to chemical process submodels can be applied to aquatic pollution problems using literature values for chemical properties. The chemical transport and fate model TOXIWASP is linked with the hydrodynamic model DYNHYD to calculate the upstream migration of seven volatile organic chemicals from a waste water effluent to a drinking water treatment plant in Philadelphia, Pennsylvania. Four steps of data acquisition and simulation are described: (1) hydrodynamics; (2) mass transport; (3) sediment transport; and (4) chemical transport and transformation. Graphs and statistics indicate good agreement between simulation results and observed concentrations. Medians are predicted within factors of 1 to 4 for the different chemicals. Confidence intervals about the predictions generally envelop observed ranges. Effluent concentration estimates provide the largest source of uncertainty. Existing transport models may be adequate, but could be improved with refinement and recalibration. Volatilization kinetics are handled well enough. (Author's abstract)
W88-03792

POLLUTANT WASHOFF BY OVERLAND FLOW,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
A. O. Akan.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 811-823, August 1987. 5 fig, 1 tab, 13 ref.

Descriptors: *Model studies, *Path of pollutants, *Runoff, *Overland flow, *Washoff, Convection, Equations, Pollutants, Transport, Shear stress, Hydrology, Basins.

A physically based mathematical model is presented for the process of pollutant washoff by overland flow on impervious surfaces. The model is based on the kinematic overland flow and convective pollutant transport equations. The pollutant detachment rate at any point along a surface is assumed to be proportional to the overland flow bottom shear stress and the amount of the pollutant on the surface. The constant of proportionality depends only on the pollutant characteristics, and therefore it can be treated as a calibration parameter insensitive to changes in the hydrologic conditions of the basin. The governing equations are written in dimensionless form, and are solved using an implicit finite difference scheme. The mathematical model is verified with a set of published experimental data. Based on the concept of hydraulic similarity, the results of the model are generalized and presented in chart form. (Author's abstract)
W88-03798

LAKE ACIDIFICATION MODEL: PRACTICAL TOOL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-03803

EFFECTS OF SIMULATED RAIN ON THE TRANSPORT OF FONOFOS AND CARBOFURAN FROM AGRICULTURAL SOILS IN A TREE-PART ENVIRONMENTAL MICROCOSM,
Wisconsin Univ.-Madison. Dept. of Entomology.
E. P. Lichtenstein, and T. T. Liang.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 35, No. 2, p 173-178, April 1987. 3 fig, 6 tab, 11 ref.

Descriptors: *Pesticides, *Path of pollutants, *Agricultural soil, *Groundwater pollution, *Fish, *Precipitation, Carbon radioisotopes, Water pollution sources, Mosquitoes, Simulated rainfall, Soil contamination, Fonofos, Carbofuran, Toxicity.

In order to determine the effects of precipitation on the migration and metabolism of pesticides through agricultural soils a laboratory study was carried out using two carbon radioisotope-labeled insecticides, fonofos and carbofuran. Radiocarbon derived from both the insecticides was transported with soil runoff water from the place of insecticide application through previously insecticide-free deeper soil layers into aquaria water and its sedi-

ments. Due to the lower water solubility of fonofos, less of this chemical was transported with water than occurred with carbofuran. Water, after its percolation through insecticide-free soil, contained 1.3% and 15.3% of the originally applied fonofos- and-carbofuran-derived radiocarbon and < 0.1% and 9.1% of the originally applied insecticides in the form of fonofos and carbofuran, respectively. Exposure of mosquito larvae to runoff water, percolated water, and aquaria water from carbon radioisotope-labeled fonofos-treated soils resulted in lower insect mortalities than did exposure of larvae to comparable water samples from carbon radioisotope-labeled carbofuran-treated soils. Thirty-six days after the start of the experiments and 21 days after the last rain application, aquaria water plus sediments of carbon radioisotope labeled fonofos- or carbofuran- treated soils contained a total of 1.3% and 6% of the originally applied radiocarbon, respectively, but no fonofos and less then 0.1% of the originally applied carbofuran. (Ray-PTT)
W88-03809

LEGIONNAIRES' DISEASE OUTBREAKS - THE ENGINEERING IMPLICATIONS,
D. Harper.
Journal of the Royal Society of Health, Vol. 107, No. 1, p 5-7, 10, February 1987. 9 ref.

Descriptors: *Legionnaires' disease, *Bacteria growth control, *Cooling towers, *Human diseases, *Domestic water, *Chlorination, Humidifiers, Residual chlorine, Hot water storage.

Cooling waters and domestic water systems are the sources of the bacterium that causes Legionnaires' disease with hot water systems being the prime source. The infection occurs not only by ingestion but also through inhalation of water droplets. It is not certain which factors are associated with the growth of this bacterium. However, temperature appears to be most important. This bacterium seems to thrive in stagnant waters at 20-45 C. The most critical temperature is 36 C. Although the Legionnaire's bacterium can grow in waters from mains in which the water is chlorinated to 0.5 ppm, it is susceptible to higher concentrations of free residual chlorine. To prevent outbreaks of Legionnaires' disease the following steps are necessary: All cold water supplied (other than drinking water) should contain 1-2 ppm free residual chlorine. All cold water storage tanks should be inspected regularly. The temperature of the tank should preferably be below 20 C. All tanks should be cleaned thoroughly each year. Cold water storage systems consisting of pressurized vessels and storage tanks should be initially chlorinated to 20 ppm and held at this level for a minimum of 2 hr. Then the whole system should be emptied and refilled. A continuous chlorination using sodium hypochlorite should be installed maintaining a free chlorine level of 1-2 ppm. Central storage cisterns should be modified so that one section contains soft water only for hot water supply. This water should contain 1-2 ppm of free chlorine. All hot water should be stored at about 60 C and maintained in pipework within + or - 5 C. All domestic hot water systems should be thoroughly cleaned and if needed should be superchlorinated with sodium hypochlorite. Cooling towers should be checked for the presence of bacterium and proper treatment should be undertaken to make the system clean. (Ray-PTT)
W88-03821

MICROWAVE DIGESTION TECHNIQUES IN THE SEQUENTIAL EXTRACTION OF CALCIUM, IRON, CHROMIUM, MANGANESE, LEAD AND ZINC IN SEDIMENTS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-03825

METHOD FOR DETERMINATION OF OXYGEN-18 OF HYDROGEN PEROXIDE IN RAINWATER,
Argonne National Lab., IL. Chemical Technology Div.
For primary bibliographic entry see Field 5A.
W88-03826

DETERMINATION OF ORGANIC COMPOUNDS LEACHED FROM MUNICIPAL INCINERATOR FLY ASH BY WATER AT DIFFERENT PH LEVELS,
Waterloo Univ. (Ontario).
F. W. Karasek, G. M. Charbonneau, G. J. Reuel, and H. Y. Tong.
Analytical Chemistry ANCHAM, Vol. 59, No. 7, p 1027-1031, April 1987. 4 fig, 4 tab, 7 ref.

Descriptors: *Fly ash, *Leaching, *Path of pollutants, *Landfills, *Water pollution sources, *Halogenated organics, Gas chromatography, Hydrocarbons, Phenols, Organic compounds, Mass spectroscopy.

The possibility that organic compounds may enter the environment through the leaching of municipal incinerator fly ash with water was investigated. A Soxhlet extraction of fly ash with water, followed by a benzene/ water solvent extraction was used to isolate organic compounds. The pH of the extracting liquid was varied (acidic, neutral and alkaline) and both the type and amount of compounds extracted differed. Many organic compounds including polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polycyclic aromatic compounds, phenols, and hydrocarbons were found in the water extracts. Gas chromatography/flame ionization detection, gas chromatography/electron capture detection, and gas chromatography/mass spectrometry using electron impact, positive and negative ion chemical ionization techniques were used for compound identification and quantitation. The toxic organics, dioxins and other polychlorinated organics were present in trace quantities, parts per billion to parts per trillion levels. There are several differences between the leaching occurring in a Soxhlet extractor and that occurring at a landfill site, e.g., higher temperature in the extractor and effects of surrounding matrix at the landfill. The Soxhlet extraction procedure allows for a rapid and systematic study of leached compounds but more study is needed to see how these results correspond to actual leaching occurring in a landfill. (Ray-PTT)
W88-03827

PCB CONTAMINATION OF A PRIVATE WATER SUPPLY,
C. Fitzgerald.
Water Well Journal WWJOA9, Vol. 41, No. 5, p 38-41, May 1987. 1 fig, 4 tab.

Descriptors: *Polychlorinated biphenyls, *Water pollution sources, *Water pollution treatment, *Wells, *Submersible pumps, *Decontamination, Pipes, Domestic water.

A private well in rural Wisconsin was contaminated by polychlorinated biphenyls (PCB). The source of PCB was a leaking submersible pump capacitor containing PCB fluid. Wisconsin Department of Natural Resources conducted an extensive study of the incident. The conclusion of the study was: PCB contamination of a water supply can be difficult to diagnose. PCB tends to accumulate in sediments and deposits in wells and piping and provide for reservoirs of PCB to the drinking water supply. Decontamination of a water supply can be successful using Dawn detergent or other surfactants in conjunction with a complete draining and flushing of sediments and scales from the water supply. However, decontamination of the hot water section of the water supply system is extremely difficult. In cooperation with pump manufacturers, the Wisconsin Department of Natural Resources has complied a list of submersible pumps which contain PCB fluids. (Ray-PTT)
W88-03836

EXTREME EVENT ANALYSIS OF PESTICIDE LOADS TO SURFACE WATERS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Heath.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 284-288, May 1987. 5 fig, 5 tab, 12 ref.

Descriptors: *Water pollution sources, *Runoff, *Mathematical models, *Pesticides, *Nonpoint pollution sources, *Risk assessment, Simulation, Water quality models, Monte Carlo method, Atrazine, Carbofuran.

Risk assessment of surface waters pollution by pesticides requires probabilities analyses of extreme chemical loads. A Monte Carlo simulation procedure was used to estimate probabilities of annual and monthly maximum daily pesticide loads in runoff. The procedure demonstrates Atrazine and carbofuran runoff for two soil types in New York, Georgia, Iowa, Texas, and Kentucky. Based on 100-yr simulation runs, annual maximum daily loads for 5-yr return periods range from 0.8 to 4.3% of application for atrazine, and 1.1 to 8.2% of application for carbofuran. Comparable values for 20-yr return periods are 1.8 to 6.8% for atrazine and 2.9 to 14.6% for carbofuran. (Ray-PTT)
W88-03856

HEAVY METALS IN SOIL FROM LAND RECLAMATION WITH SLUDGE,
Indiana Univ. of Pennsylvania.
For primary bibliographic entry see Field 5E.
W88-03858

MODELING THE TRANSPORT OF FINE-GRAINED SEDIMENTS IN AQUATIC SYSTEMS,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W88-03860

SUSPENDED MATTER PROPERTIES AND ITS ROLE IN POLLUTANT TRANSFER FROM THE RIVER TO THE SEA. CASE STUDY: ADIGE RIVER-ADRIATIC SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
M. Juracic, L. M. Vitturi, S. Rabitti, and G. Rampazzo.
Science of the Total Environment STENDL, Vol. 55, p 243-249, 1986. 3 fig, 1 tab, 7 ref. Italian C.N.R. grant no. 84.00287.05.

Descriptors: *Path of pollutants, *Adige River, *Suspended solids, *Sediments, *Heavy metals, *Sediment transport, *Suspended load, Chromium, Estuaries, Italy, Adriatic Sea, River sediments, Marine sediments.

Suspended matter and bottom sediments were investigated in the Adige River estuary (Northern Adriatic Sea) and their role in the heavy metals transfer from land to sea was examined. The observed similarity of the geochemical and mineralogical composition between the riverine suspended matter and the marine sediments just at the Adige mouth reveals that most of the riverborne suspended particles settle in the prodelta area together with the associated heavy metals. Among the various toxic elements examined, chromium behaves differently, which indicates man's influence on its biogeocycle. (Author's abstract)
W88-03862

SURVEY OF FARM WELLS FOR PESTICIDES RESIDUES, SOUTHERN ONTARIO, CANADA, 1981-1982, 1984,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Agricultural Lab. Services Branch.
R. Frank, B. D. Ripley, H. E. Braun, B. S. Clegg, and R. Johnston.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 1-8, January 1987. 1 fig, 7 tab, 19 ref.

Descriptors: *Farms, *Pesticide residues, *Well contamination, *Water pollution sources, *Well water, Insecticides, Fungicides, Herbicides,

*Canada, Cropland, Diazinon, Malathion, Allidochlor, Linuron, Prometryne, Rural areas.

Water samples from 11 wells located in an area of intensive vegetable production on an organic soil were collected in 1981 and 1982, and analyzed for pesticide residues. Residues of diazinon, malathion, allidochlor, linuron, and prometryne were identified in four of the wells. Water samples from 91 wells were collected from farms on mineral soil across Southern Ontario during 1984 and analyzed for pesticide residues. Atrazine residues (0.1 to 74 microgram/L) were present in 11 wells and trifluralin residues (41 microgram/L) contaminated one well. The highest residue of atrazine (74 microgram/L) was present in one well along with contamination of three other herbicides and one insecticide. This was the result of a spill into the drilled well that gave residues of each component between 22 and 125 microgram/l. After 10 months of cleaning, this well was still contaminated. (Author's abstract)
W88-03864

INVESTIGATION OF PESTICIDE CONTAMINATION IN RURAL WELLS, 1979-1984, ONTARIO, CANADA,
Ontario Ministry of Agriculture and Food, Guelph (Ontario). Agricultural Lab. Services Branch.
R. Frank, B. S. Clegg, B. D. Ripley, and H. E. Braun.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 9-22, January 1987. 11 tab, 23 ref.

Descriptors: *Water pollution sources, *Well water, *Pesticides, *Well contamination, *Rural wells, Pesticide residues, Farm wells, Canada, Atrazine, Drinking water, Dichlorprop.

Between the years 1979 and 1984, investigation were conducted into 311 suspected contaminations of wells with pesticides. This involved the analyses of water from 359 wells where the suspected contamination originated from (1) spills, (2) spray drift, or (3) surface runoff water carrying pesticides into wells. Investigations covered 83 spill events involving 104 rural wells; tests revealed 79 of these became contaminated. In spite of cleaning attempts, difficulty was experienced in decontaminating most well water and some had to be abandoned. Investigations were made into 228 events involving 255 wells where spray drift and/or surface runoff waters with pesticides were observed entering the well; however, only 55 contained detectable residues. The highest proportion of these events was associated with surface runoff or spray drift from cornfields; of 86 wells involved only 26 contained measurable residues and all involved atrazine. Fifty-seven well investigations were associated with spraying right-of-ways and 16 waters were contaminated with 2,4-d and dichlorprop. The remaining 13 well contaminations were associated with various other land-use activities. It required 45-347 days to decontaminate these 35 wells. In Ontario, Canada, water for spraying pesticides is drawn from farm wells, ponds, ditches, and streams. The normal procedure is to fill the spray equipment directly from the water source, although filling from a mobile water tank is quite common. According to the Ontario Pesticide Act of 1973, an anti-backflow device must be used when drawing from surface water. No such device is mandatory for drawing water from a private well or farm pond. Loading and mixing the pesticide is advisably performed away from the water source. These procedures are not always followed and accidents have resulted in a number of wells being contaminated annually. This may be followed by nausea among those drinking the water. (Ray-PTT)
W88-03865

ALDRIN, DIELDRIN, AND MERCURY PROFILES IN RECENT LAKE SEDIMENTS AT THE ROCKY MOUNTAIN ARSENAL, COLORADO,
Colorado Cooperative Fishery Research Unit, Fort Collins.
E. P. Bergersen.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 61-67, January 1987. 5 fig, 2 tab, 15 ref.

Descriptors: *Lake sediments, *Aldrin, *Dieldrin, *Mercury, *Rocky, *Water pollution sources, *Path of pollutants, Mountain arsenal, Sediments, Sedimentation rates, Pesticides, Heavy metals, Industrial wastes.

Sediment cores from two lakes at the U.S. Army Rocky Mountain Arsenal, Colorado, where chemical compounds were manufactured and stored for 40 years, were examined to determine the distribution of aldrin, dieldrin, and mercury in sediments and their probable dates of deposition. Sedimentation rates based on direct and indirect Cs137 measures, were estimated to be 1.91 and 1.23 cm/yr in the two lakes. Contaminant deposition dates, as judged by these sedimentation rates, varied between and within lakes; levels of contaminants were relatively high before 1970. The presence of elevated concentrations of all three contaminants in more recent sediments in one lake suggested migration within the sediments or delayed discharges from the manufacturing facility. (Author's abstract)
W88-03868

CHANGES IN THE AQUEOUS BEHAVIOR OF PARATHION UNDER VARYING CONDITIONS OF HYDROGEN ION CONCENTRATION,
Ohio State Univ., Columbus. Dept. of Entomology.
S. W. Fisher, and T. W. Lohner.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 79-84, January 1987. 2 fig, 4 tab, 27 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Parathion, *Hydrogen ion concentration, *Toxicity, *Microorganisms, *Pesticides, Midger.

Factors affecting the stability of parathion in the aquatic environment were studied, with emphasis on pH. Radioactive Carbon fourteen labeled parathion was used to monitor the degradation. In 24-hr toxicity tests, using the midge, parathion was significantly more toxic at pH 6 than at 4 and 8. While the data from toxicity tests suggested that pH may be important in determining the environmental fate of parathion, pH was insignificant in controlling levels of parathion in water and organisms of aquatic microcosms adjusted to pH 4, 6, and 8. After 7 days, parathion accounted for 29.7%, and 36.6% of total radioactivity in the water of microcosms held at pHs 4, 6, and 8, respectively. In abiotic water, however, no parathion breakdown was observed in 40 days at any of the three pH levels. These data demonstrate the importance of biotic factors, particularly microorganisms, in degrading parathion. Microorganisms which metabolize parathion in the microcosms were not adversely affected by changes in pH. (Author's abstract)
W88-03869

CADMIUM KINETICS IN FRESHWATER CLAMS. III EFFECTS OF ZINC ON UPTAKE AND DISTRIBUTION OF CADMIUM IN ANODONTA CYGNE,
Utrecht Rijksuniversiteit (Netherlands). Lab. of Chemical Animal Physiology.
For primary bibliographic entry see Field 5C.
W88-03870

RUTILE FIBERS IN SURFACE WATERS OF NORTHERN NEW JERSEY,
Rutgers - The State Univ., Newark, NJ. Dept. of Geology.
J. H. Puffer, M. Germine, and G. P. Maresca.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No.1, p 103-109, January 1987.

Descriptors: *Rutile Fibers, *Surface waters, *Water pollution sources, *Asbestos, Transmission electron microscopy, Drinking water, Rutile.

The occurrence of rutile fibers, naturally occurring flexible with the properties of asbestos, was determine amounts of rutile fibers in northern NJ surface waters. Transmission electron microscope (TEM) analyses of these surface waters indicate that rutile is a consistent contaminant, with fiber concentrations ranging from 0.2 to 1.5 million fibers/L (MFL). The source of rutile in the surface waters is the bedrock. Hydraulic parameters indicate that rutile in the surface water samples is entirely in the Wentworth clay range, with Stokes' diameter of < 2 microns and suggest a high degree of sorting control over suspended particles. Since the samples were all from actual or potential sources of drinking water, the results suggest that a substantial amount of rutile is ingested via surface water supplies by the general population. The health effects of such ingestion are unknown. (Ray-PTT)
W88-03871

SELECTED PAPERS IN THE HYDROLOGIC SCIENCES, 1985.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W88-03884

LOW-LEVEL RADIOACTIVE GROUNDWATER CONTAMINATION FROM A COLD SCRAP RECOVERY OPERATION WOOD RIVER JUNCTION, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
B. J. Ryan, and K. L. Kipp.
In: USGS Water-Supply Paper 2270, 1985. p 21-34, 10 fig, 1 tab, 10 ref.

Descriptors: *Contamination, *Radioactive wastes, *Groundwater pollution, *Rhode Island, Strontium radioisotopes, Nitrates, Wastewater lagoons, Glacial aquifers, Unconfined aquifers, Swamps, Lower Wood aquifer, Wood River Junction.

Liquid wastes from a uranium-bearing cold scrap recovery plant at an industrial site in Wood River Junction, Rhode Island, were discharged to the environment through evaporation ponds from 1966-1980. Leakage from lined ponds resulted in a plume of contaminated groundwater that extends from the ponds to the Pawcatuck River through a highly permeable sand and gravel aquifer. Water quality data from more than 100 observation wells indicate that the plume is 2300 ft long, 300 ft wide, and is confined to the upper 80 ft of saturated thickness where sediments consist of medium to coarse sand and gravel. No contamination has been detected in fine sands and silts underlying the coarser materials. Piezometric-head and water-quality data from wells screened at multiple depths on both sides of the river indicate that contaminants discharge both to the river and to a swampy area at the west edge of the river. Strontium 90, technetium 99, boron, nitrate, and potassium exceed background concentrations by an order of magnitude in much of the plume. Water quality sampling conducted from April 1981 to June 1983 indicate concentrations of gross beta emitters and electrical conductivity of the water ranges from 5 to 500 picoCuries/L and 150 to 4500 micromhos/centimeter at 25 C, respectively. (See also W88-03884) (USGS)
W88-03886

ELECTROMAGNETIC METHOD FOR DELINEATING GROUNDWATER CONTAMINATION, WOOD RIVER JUNCTION, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
P. M. Barlow, and B. J. Ryan.
In: USGS Water-Supply Paper 2270, 1985. p 35-50, 14 fig, 2 tab.

Descriptors: *Geophysics, *Pollutants, *Glacial aquifers, *Conductivity, *Groundwater pollution, *Radioactive wastes, *Path of pollutants, *Rhode Island, *Pawcatuck River, Electrical studies, Wood River Junction.

Surface electromagnetic induction techniques that measure terrane conductivity were used at a low-level radionuclide waste site in Wood River Junction, Rhode Island to delineate extent of contamination in a sand and gravel aquifer. Data from both terrane and specific-conductance surveys indicate that a plume of contaminated groundwater extends from wastewater lagoons and trenches at the plant site to the Pawcatuck River. Above background terrane conductivities are present over an area that is 370 meters long and ranges in width from 100 to 200 meters. Electromagnetic data contoured in linear units emphasized high conductivity zones that were potential contaminant sources. Linear contouring also depicted changes in conductivity with depth more clearly than did logarithmic contouring. Logarithmic contouring of electromagnetic data was successful in masking background noise, thereby delineating more clearly boundaries of the contamination plume. Selection of background apparent-conductivity value at the site for the logarithmic contouring schemes proved to be the greatest drawback to the logarithmic method. (See also W88-03884) (USGS)
W88-03887

MEASUREMENT OF REAERATION IN A LARGE RIVER BY THE MODIFIED TRACER TECHNIQUE,
Geological Survey, Indianapolis, IN. Water Resources Div.
C. G. Crawford.
In: USGS Water-Supply Paper 2270, 1985. p 69-82, 6 fig, 5 tab, 21 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Indiana, *Reaeration, *Wabash River, Oxygen transfer.

The modified tracer technique was used to measure reaeration in the Wabash River near Lafayette and Terre Haute, Indiana, at streamflows ranging from 65 to 210 cu meters/sec. Chemically pure grade ethylene was used as the tracer gas, and rhodamine-WT dye was used as the dispersion-dilution tracer. Injection efficiencies for the ethylene were estimated to range from 16% (when the diffusers were submerged in 0.6 meters of water) to 64% (when the diffusers were submerged in 3.4 meters of water). Rates of recovery of the rhodamine-WT dye ranged from 83 to 98% and were lowest at the highest streamflows. Reaeration coefficients measured in a 29.7 kilometer reach near Lafayette, Indiana, at streamflows of 65 and 97 cu meters/sec were 1.2 and 0.8 per day, respectively, at 20 C. Reaeration coefficients measured in a 21.8 kilometer reach near Terre Haute, Indiana, at streamflows of 95 and 210 cu meters/sec were 1.4 and 1.1/day, respectively, at 20 C. None of the common equations found in the literature predicted reaeration coefficients similar to those measured for the Lafayette and Terre Haute reaches of the Wabash River. Confidence limits of results obtained from the modified tracer techniques were smaller than those obtained for reaeration from the equations in the literature. (See also W88-03884) (USGS)
W88-03889

PERFORMANCE OF SODIUM AS A TRANSPORT TRACER-EXPERIMENTAL AND SIMULATION ANALYSIS,
Geological Survey, Menlo Park, CA. Water Resources Div.
K. E. Bencala.
In: USGS Water-Supply Paper 2270, 1985. p 83-90, 3 fig, 9 ref.

Descriptors: *Solute transport, *Tracers, *Sodium, *California, Streams, Experimental watersheds, Low flow, Water quality, Simulation analysis, Sorption, Uvas Creek, Santa Clara County.

As part of a field solute-transport experiment sodium was injected along with chloride and strontium into a mountain pool-and-riffle stream. Based on comparisons with the chloride and strontium transport, sodium was determined to be a potentially useful tracer although somewhat nonconservative. Three simulations of the sodium concentrations were obtained using different assumptions on the degree to which sodium was nonconservative. The simulation of sodium as conservative was typically a good reproduction of the timing of the sodium arrival, peak, and tail. The simulations of sodium as nonconservative provided somewhat closer approximations to the measured concentration values. The conservative simulation was based on stream properties determined from the chloride transport. The reactive simulation was based on additional stream-sediment parameters determined from the strontium transport and on the chemical properties of sodium. (See also W88-03884) (USGS)
W88-03890

UPTAKE AND REGENERATION OF NITRATE BY EPILITHIC COMMUNITIES IN A NEARLY PRISTINE LOTIC ENVIRONMENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W88-03891

STREAMBED OXYGEN DEMAND VERSUS BENTHIC OXYGEN DEMAND,
Geological Survey, Little Rock, AR. Water Resources Div.
J. E. Terry, and E. E. Morris.
In: USGS Water-Supply Paper 2270, 1985. p 99-112, 10 fig, 1 tab, 16 ref.

Descriptors: *Dissolved oxygen, *Oxygen demand, *Sediment-water interfaces, *Computer models, *Sediment oxygen demand, *Streambed oxygen demand, *Benthic oxygen demand, Dissolved-oxygen modeling.

In order to effectively model dissolved oxygen dynamics in a stream, all sources and sinks must be adequately simulated. In many streams, the demand for oxygen from streambed deposits is a very significant sink. Many investigators attempt to quantify this demand by analyzing 'point samples' by either in vitro or in situ methods. In terms of areal application with respect to model simulations these measurements are deficient because of the following: (1) Spatial variations due to patch deposition and distance from contributing sources; (2) Inclusion of periphytic algal respiration; and (3) Unsamplable substrates. Studies conducted by the U.S. Geological Survey on streams in Arkansas indicate that an indirect technique for the quantification of dissolved oxygen demands from streambed deposits is more practical and results in more representative values than do the analyses of 'point samples'. The application of these techniques requires that all sources and sinks for instream dissolved oxygen, except the demands from streambed deposits, be measured or determined. The demand for dissolved oxygen from streambed deposits is then quantified indirectly as the only unknown in the oxygen balance equation. Projected changes in this demand is simulated as a function of projected changes in instream organic deposition rates. (See also W88-03884) (USGS)
W88-03892

RATE OF FERROUS IRON OXIDATION IN A STREAM RECEIVING ACID MINE EFFLUENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
D. K. Nordstrom.
In: USGS Water-Supply Paper 2270, 1985. p 113-119, 3 fig, 2 tab, 27 ref.

Descriptors: *Acid mine drainage, *Acid streams, *Thiobacillus, *Iron bacteria, *California, *Iron pollution, *Fate of pollutants, Kinetics, Oxidation, Path of pollutants.

The rate of ferrous iron oxidation has been measured during downstream transport of acid mine waters in a mountainous reach, both before and after a rainstorm. The rate has a mean value of 2.7 mM/hr before the rainstorm, and 0.69 mM/hr after the rainstorm. These rates are 5 to 8 orders of magnitude faster than the inorganic reaction rate and are shown to be caused by bacterial catalysis through the iron-oxidizing bacterium, Thiobacillus ferrooxidans. The decrease in rates after the rainstorm indicates a dilution of the bacterial population. (See also W88-03884) (USGS)
W88-03893

RELATION BETWEEN GROUNDWATER QUALITY AND MINERALOGY IN THE COAL-PRODUCING NORTON FORMATION OF BUCHANAN COUNTY, VIRGINIA,
Geological Survey, Richmond, VA. Water Resources Div.
J. D. Powell, and J. D. Larson.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2274, 1985. 30 p, 11 fig, 16 tab, 17 ref.

Descriptors: *Water quality, *Geochemistry, *Coal hydrology, *Virginia, Geochemical modeling, Coal Mines, Acid mine drainage, Buchanan County.

The geochemical processes controlling groundwater chemistry in the coal-producing Norton Formation of Buchanan County, Virginia, include hydrolysis of silicates, dissolution of carbonates, oxidation of pyrite, cation exchange and precipitation of kaolinite, silica, and goethite. Core materials from the Norton Formation were used to identify minerals in the host rock. Activities of individual ions and saturation indexes of mineral phases were determined from water analyses. Reaction models based on water analyses derive sulfate from pyrite, iron from pyrite and siderite, calcium from plagioclase and calcite, sodium from plagioclase, magnesium from chlorite, and carbon from carbon dioxide, calcite and siderite. Kaolinite, silica, and goethite precipitate. Carbon-13 data define the relative contributions of carbon sources to models. Comparison of adjacent unmined and mined basins indicates that surface mining significantly increases the weathering reaction of pyrite in contrast to weathering reactions of other mineral phases. In the area studied, reactive pyrite does not appear to be present in sufficient quantities in strata associated with mined coal seams to cause acid mine drainage. (USGS)
W88-03895

EFFECTS OF LOW-LEVEL DAMS ON THE DISTRIBUTION OF SEDIMENT, TRACE METALS, AND ORGANIC SUBSTANCES ON THE LOWER SCHUYLKILL RIVER BASIN, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
T. H. Yorke, J. K. Stamer, and G. L. Pederson.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2256-B, 1985. 53 p, 29 fig, 17 tab, 36 ref.

Descriptors: *Path of pollutants, *Reservoirs, *Sediments, *Pennsylvania, *Schuylkill River, Water pollution sources, Urban hydrology, Trace metals, Heavy metals, Pesticides, Polychlorinated biphenyls.

This report presents the results of the part of the study that evaluates the effects of low-level dams in the lower Schuylkill basin, PA, on the distribution and transport of sediment and trace substances. A combination of historical and current data were used in the assessment. These data provided a base for assessing the transport of trace substances, which are associated closely with riverbed sediments and suspended particles. Water and riverbed samples were collected for analyses of trace substances at numerous sites in the lower basin from 1978 to 1980. The six dams on the river between Pottstown and Philadelphia have had a significant effect on the transport of sediment and trace substances. Between 1954 and 1970, more than 4.7 million cu yards of sediment accumulated in the pools formed by the dams. Some trace substances are associated closely with particulate material transported by the river. The concentration of suspended and total cadmium, chromium, copper, lead, nickel, and zinc correlated well with the concentration of suspended sediment and suspended organic carbon. The average annual discharge ranged from 46% for nickel to 94% for lead for the Schuylkill River at Manayunk. Con-

centrations of some trace metals in the deeper sediments were 2 times higher than the concentrations in surficial sediments; concentrations of insecticides were 1.5 to 2 times higher; and concentrations of polychlorinated biphenyls were 2 times higher in the deeper deposits. (USGS)
W88-03896

PRIMER ON TRACE METAL-SEDIMENT CHEMISTRY,
Geological Survey, Doraville, GA. Water Resources Div.
A. J. Horowitz.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2277, 1985. 67 p, 12 fig, 26 tab, 166 ref.

Descriptors: *Sediment chemistry, *Trace metals, *Chemical partitioning, *Path of pollutants, Sediments, Physical partitioning, Fate of pollutants.

In most aquatic systems, suspended sediment, and the top few centimeters of bottom sediment, contain many times the concentration of trace metals than are dissolved in the water column. As such, the distribution, transport, and availability of these constituents can not be intelligently evaluated, nor their environmental impact determined or predicted, solely through the sampling and analysis of dissolved phases. This 'Primer' is designed to acquaint the reader with the basic principles which govern the concentration and distribution of trace metals associated with bottom and suspended sediments. Many factors affect a sediment's capacity to collect and concentrate trace metals. Physical factors include grain size, surface area, surface change, cation exchange capacity, and composition. Increases in metal concentrations are correlated with decreasing grain size and increasing surface area, surface charge, cation exchange capacity, and increasing levels of iron and manganese oxides, organic matter, and clay minerals. Chemical factors are also important, especially in terms of differentiating between samples having similar bulk chemistries and for inferring or predicting environmental availability. Chemical factors entail phase associations (with such sedimentary components as interstitial water, sulfides, carbonates, organic matter) and how the metals are entrained by the sediments (such as adsorption, complexation, within mineral lattices). (USGS)
W88-03899

INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1973-74,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-03906

GROUNDWATER HYDROLOGY AND SUBSURFACE MIGRATION OF RADIONUCLIDES AT A COMMERCIAL RADIOACTIVE-WASTE BURIAL SITE, WEST VALLEY, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Carson City, NV. Water Resources Div.
D. E. Prudic.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Professional Paper 1325, 1986. 83 p, 36 fig, 16 tab, 77 ref.

Descriptors: *Groundwater movement, *Glaciohydrology, *Radioactive-waste disposal, *Model studies, *Path of pollutants, Hydrologic modeling, West Valley, Cattaraugus County, New York, Radionuclide migration.

Low-level radioactive wastes were buried from 1963-75 in trenches excavated in a clay-rich till about 28 meters thick. Beneath the till is a lacustrine sequence that is unsaturated in its upper part and acts as a drain to the till. The till is nearly isotropic; hydraulic conductivity ranges between 2 times 10 to the minus 8th power and 6 times 10 to the minus 8th power centimeters/sec. Fractures with oxidized walls extend as much as 5 meters below the original land surface. The fractured till is 5 to 10 times more permeable than the deeper unfractured till, as determined from computer simulations. The direction of groundwater flow in the till is predominantly downward, with an average linear pore velocity of 1 to 8 centimeters/year. Tritium migrated less than 3 meters from three trenches in the 7 to 11 years after they were completed. Carbon-14 migrated less than 1 meter, and migration of other radionuclides is apparently even less. The migration of tritium and carbon-14 occurs chiefly by diffusion. Radionuclides are far less likely to reach the surface environment by subsurface flow through the till than by seepage of trench water through the trench covers, which can occur whenever trenches become filled with water from recharge entering through cracks that form in the cover. (USGS)
W88-03909

NATIONAL WATER SUMMARY 1984--HYDROLOGIC EVENTS, SELECTED WATER-QUALITY TRENDS, AND GROUNDWATER RESOURCES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03910

WATER QUALITY OF LAKE GRANBURY, NORTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2H.
W88-03928

POLLUTION POTENTIAL OF PIT QUARRIES EMPLOYED AS WASTE DISPOSAL SITES,
Missouri Univ.-Rolla. Dept. of Geophysics.
For primary bibliographic entry see Field 5E.
W88-03933

POTENTIAL GROUNDWATER IMPACTS FROM CHEMIGATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Warner, and K. Nielsen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-187357/AS. Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins. Completion Report No. 141. September 1986. 60 p, 26 fig, 3 tab, 4 ref, append. Contract No. 14-08-0001-G1006. Project No. USGS G1006-02.

Descriptors: *Chemigation, *Irrigation wells, *Groundwater pollution, Computer models, Finite element method, Sprinkler irrigation, Irrigation systems, Pesticides, Fertilizers, Aquifers, Simulation analysis, Path of pollutants, Nitrates.

Chemigation is the practice of applying fertilizers/pesticides through a center pivot sprinkler irrigation system. Chemigation is becoming increasingly more common and has several economic and environmental advantages. However, regulating agencies have expressed concern about the potential groundwater contamination that may result from widespread use of chemigation. The concern is that if the irrigation well fails during the chemigation cycle then the fertilizer/pesticide may be back-siphoned down the well and into the aquifer. In this study the fate in the groundwater system of these back-siphoned chemicals was investigated using a digital contaminant transport model developed at Colorado State University by the principal investigator. The model was used to simulate the effect of various breakdown scenarios, aquifer properties and stresses, quantities back-siphoned, and different chemical characteristics of the contaminant. Both conservative and nonconservative contaminant transport was modeled. In the conservative case, nitrate was simulated to represent the back flow of a fertilizer down the well. The typical chemigation system layout simulated for this case consisted of a quarter section sprinkler and a 1,000 gallon chemical storage tank. In the model simulations the removal of the nitrate from the aquifer was accomplished by restarting the irrigation well. About 1-1/2 days of pumping were required to lower the nitrate concentrations to safe levels. A delay of one week in restarting the irrigation well after breakdown increased slightly the pumping time required to remove the nitrate from the aquifer. In the nonconservative case, a pesticide was simulated to represent the back flow of a reactive contaminant that would be adsorbed on the solids aquifer skeleton. The adsorption of the pesticide greatly retarded the movement of the contaminant away from the irrigation well. However, desorption occurred slowly and it greatly increased the pumping time required to remove the contaminant from the aquifer. (USGS)
W88-03938

WATER QUALITY OF LAKE WHITNEY, NORTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2H.
W88-03944

GEOLOGICAL ASPECTS OF ACID DEPOSITION.
Acid Precipitation Series, Volume 7, Butterworth Publishers, Boston. 1984. Volume edited by Owen P. Bricker. Series edited by John I. Teasley. 143 p.

Descriptors: *Fate of pollutants, *Geochemistry, *Acid rain, Precipitation, Soil chemistry, Fallout, Metals, Nutrients, Water pollution effects, Acidic water, Chemical reactions, Water pollution sources, Weathering.

Acid deposition is discussed from a geological perspective. Acid precipitation reacts with the materials of the lithosphere (bedrock, sediment, soil), depending on its chemical and physical nature. A geochemical mass balance shows that major inputs of sulfur and nitrogen acidic materials are anthropogenic. About 15% of the total cation denudation rate for the eastern U.S. is attributable to weathering of soil and rock by acid precipitation. In New England lakes zinc and lead levels in sediments have increase 2-10 times the background levels since 1860-1880 while calcium and manganese levels have declined. A hierarchial classification of soils and rocks which promote neutralization of acid precipitation shows that the areas most susceptible to acid rain effects have thin or no soils, no sedimentary minerals, and massive silicate bedrock. Aluminum levels in Adirondack surface waters speciate into inorganic monomeric aluminum, organic monomeric aluminum, and acid-soluble aluminum, depending on acidity of the water and level of organic matter. These components vary temporally. Forested watersheds lose less Mg, Ca, and K nutrients when exposed to acid rain than does pastureland and cropland in the Rhode River, Maryland, estuary region. Mapping shows the areas of eastern Canada most sensitive to acid precipitation, about 59% of the region. (Cassar-PTT)
W88-03961

GEOCHEMICAL MASS BALANCE FOR SULFUR- AND NITROGEN- BEARING ACID COMPONENTS: EASTERN UNITED STATES,
Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.
W. D. Bischoff, V. L. Paterson, and F. T. MacKenzie.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 1-21, 8 fig, 5 tab, 30 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Acid rain, *Geochemistry, Sulfates, Nitrates, Sulfur dioxide, Nitrogen oxides, Model studies, Air pollution, Fallout, Weathering, Rocks, Neutralization, Precipitation.

The geochemical mass balance was developed to evaluate the acid precipitation problem in the eastern U.S. A number of conclusions were drawn from the modeling effort. Major inputs of sulfur dioxide and nitrogen oxides into the atmosphere in this region are anthropogenic. Biogenic sources

and anthropogenic fluxes from outside the region are probably insignificant. The main removal process is atmospheric transport, accounting for 55% of SO2 and 75% of nitrogen oxides. Dry and wet deposition respectively account for 26% and 19% of the SO2 emissions and 5% and 19% of nitrogen oxide emissions. The complete neutralization of excess acid in acid precipitation over the eastern U.S. because of reactions with rock and soil results in a maximum stream discharge of 160 billion moles/year of sulfate and 68 moles/year of nitrate. The probable maximum molar ratios of cations produced to acid consumed is 2:1 for sulfate and 1:1 for nitrate. About 15% of the total cation denudation rate for the region can be attributed to weathering of soil and rock by acid precipitation. (Cassar-PTT)
W88-03962

CHRONOLOGY, MAGNITUDE AND PALEOLIMNOLOGICAL RECORD OF CHANGING METAL FLUXES RELATED TO ATMOSPHERIC DEPOSITION OF ACIDS AND METALS IN NEW ENGLAND,
Maine Univ. at Orono. Dept. of Geological Sciences.
J. S. Kahl, S. A. Norton, and J. S. Williams.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 23-35, 6 fig, 4 tab, 23 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Geochemistry, *Lake sediments, Metals, Heavy metals, Fallout, Paleolimnology, Sediments, Calcium, Manganese, Lead, Zinc, Magnesium, Precipitation.

Zinc and lead concentrations and deposition rates in sediments of three New England lakes began increasing (but at different rates) about 1860-1880. Maximum concentration increases range from 2 to 10 times background. Sediment concentrations of calcium and manganese decline concurrently with the increase in heavy metals. These processes are attributed to increased loading of metals and acids from precipitation since that time. Maximum deposition rates of lead and zinc range from 1 to 3 micrograms/sq cm/yr for the three lakes. Maximum deposition rates for lead occur in the youngest sediment. However, recent sediments are depleted of zinc in spite of increased atmospheric loading. Watershed contribution and in-lake focusing processes cause nonuniform deposition of metals. Allochthonous alkali-leached but heavy-metal-laden detritus has strongly influenced sediment chemistry in acidified watersheds for >100 years. Additionally, lakewater-sediment interactions may sensibly alter sediment chemistry (Ca, Mn, and possibly Zn) and water chemistry (Al, Mn, and Zn) as the lakes become acidified. (Author's abstract)
W88-03963

ACID RAIN NEUTRALIZATION BY GEOLOGIC MATERIALS,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
N. M. Johnson.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 37-53, 2 tab, 16 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Geochemistry, *Precipitation, *Neutralization, Chemical reactions, Soil chemistry, Bedrock, Silicates, Sedimentary rocks, Carbonates, Fallout, Sulfates, Nitrates, Hydrolysis, Kinetics, Weathering, South Cascade glacier, Jamieson Creek, Hubbard Brook.

Soils and rocks composed of carbonates, clays, and gibbsite-related minerals quickly neutralize acid rain at relatively low temperatures. Quartz and silicates hydrolyze very sluggishly, and soils composed of these minerals are vulnerable to the effects of acid rain. Highly polymerized silicates are the most difficult to hydrolyze. Aluminum substitution in tetrahedral positions renders a silicate structure more vulnerable to hydrolysis or acid attack. Conditions which promote neutralization of acid rain include increased surface area of the solid (finely ground or defective crystals), lack of growth of new minerals, and hot climates. A hierarchy of reactions that provide acid sinks are given in order of decreasing availability in a kinetic sense: (1) free-base pools of the soil such as soil-water alkalinity, (2) secondary minerals in the soil zone such as calcite, (3) sedimentary minerals in the bedrock such as carbonates and clays, and (4) silicates of the bedrock. The presence of any acid sink higher in the hierarchy preempts the action of sinks lower than itself. The areas sensitive to acid rain are missing the top items of the hierarchy. They have thin or no soils, no sedimentary minerals, and a massive silicate bedrock. Evidence so far suggests that acid rain has not greatly changed the amount of hydrolysis weathering taking place; however, the kind of hydrolysis has changed substantially. (Cassar-PTT)
W88-03964

ALUMINUM SPECIATION AND EQUILIBRIA IN DILUTE ACIDIC SURFACE WATERS OF THE ADIRONDACK REGION OF NEW YORK STATE,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, J. P. Baker, J. J. Bisogni, and C. L. Scofield.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 55-75, 8 fig, 5 tab, 40 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Geochemistry, *Aluminum, Chemical reactions, Adirondacks, Equilibrium, Surface water, Precipitation, Snowmelt, Seasonal variation, Organic matter, Organic carbon, Fluorides, Equilibrium, Podzols, Gibbsite, Acidic water.

Aluminum levels in Adirondack surface waters, sampled 15 times during a year, were extremely variable. Although data were very scattered, a general trend indicated that total aluminum levels increased with decreases in pH below 5.0. At neutral pH, inorganic monomeric aluminum levels were low. As pH decreased, the inorganic monomeric aluminum levels increased exponentially. Concentrations of organic monomeric aluminum appeared to be independent of pH. However, the level of organic monomeric aluminum was significantly correlated with total organic carbon concentrations. Acid-soluble aluminum occurred in low concentrations. Levels remained constant at a given site, and levels did not correlate with pH or total organic carbon. Temporal variations in aluminum level and form reflected temporal variations in pH and organic carbon levels. Inorganic aluminum levels increased in streams during rainfall and snowmelt events when water flow was high and pH values were low. During low-flow, neutral-pH conditions inorganic monomeric aluminum levels were very low. During summer when microbial decomposition was greatest and podzolization was intense, total organic carbon levels and organically complexed aluminum levels both increased. The bulk of aluminum in Adirondack waters sampled was complexed with either natural organic matter or fluoride. (Cassar-PTT)
W88-03965

REGIONAL ASSESSMENT OF SENSITIVITY TO ACIDIC DEPOSITION FOR EASTERN CANADA,
Department of the Environment, Burlington (Ontario). Hydrology Div.
A. E. Lucas, and D. W. Cowell.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 113-129, 3 fig, 5 tab, 33 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Geochemistry, Acid water, Canada, Maps, Bedrock, Soil chemistry, Fallout, Sulfates, Precipitation.

The sensitivity of surface waters in eastern Canada to acid rain was assessed using a set of factors and mapping. Three sensitivity classes are identified. Each class has 3 to 7 subclasses of soil and bedrock characteristics. About 20% of eastern Canada has high potential for reducing acidity. Of this, 75% is associated with limestone bedrock in Ontario. A total of 21% of eastern Canada has a moderate potential to reduce acidity. These are shallow sandy soils overlying bedrock of moderate potential. This combination covers >60% of Labrador. Low potential for reducing acidity is found in 59% of eastern Canada. Large portions of Ontario and Quebec (29% and 35%, respectively) are associated with deep sands or nonlimey soils. An area of 405,000 sq km not only receives at least 20 kg/ha/yr of wet sulfate, but it is highly sensitive to the effects of acid deposition. This amounts to about 13% of the total area of eastern Canada. (Cassar-PTT)
W88-03967

INFLUENCE OF DISPOSAL ENVIRONMENT ON AVAILABILITY AND PLANT UPTAKE OF HEAVY METALS IN DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
B. L. Folsom, C. R. Lee, and D. J. Bates.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-112279. Price codes: A08 in paper copy, A01 in microfiche. Technical Report EL-81-12, December 1982. Final Report. 158 p, 25 fig, 52 tab, 142 ref, append.

Descriptors: *Fate of pollutants, *Metals, *Aquatic plants, *Dredging, Heavy metals, Sediments, Marine sediments, Accumulation, Bioaccumulation, Oxidation, Zinc, Cadmium, Copper, Iron, Manganese, Arsenic, Mercury, Nickel, Chromium, Lead.

Heavy metal uptake by Cyperus esculentus from 15 highly contaminated freshwater sediments under reduced (flooded) and oxidized (upland) disposal conditions was investigated in the greenhouse. Heavy metal uptake by Spartina alterniflora and Distichlis spicata from 14 highly contaminated saltwater sediments under flooded disposal conditions was also investigated. Air drying the sediments increased the concentrations of DTPA-extractable (available to the plant) heavy metals especially zinc, cadmium, copper, manganese, chromium, and lead, in sediments and in interstitial water, compared with plants grown in flooded conditions. Plant uptake of heavy metals, especially zinc and cadmium, was greater in plants grown in upland sediments compared with flooded sediments. Plant yield was an important factor in determining plant uptake of heavy metals. Spartina alterniflora had higher zinc and lead concentrations and total metals uptake than did D. spicata. (Cassar-PTT)
W88-03980

DETERMINE FATES OF SEVERAL OIL SPILLS IN COASTAL AND OFFSHORE WATERS AND CALCULATE A MASS BALANCE DENOTING MAJOR PATHWAYS FOR DISPERSION OF THE SPILLED OIL,
Research Planning Inst., Inc., Columbia, SC.
E. R. Gundlach, and P. D. Boehm.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152306. Price codes: A03 in paper copy, A01 in microfiche. RPI/R/81/12-31030, December 1981. Final Report. 28 p, 3 fig, 4 tab, 90 ref. Contract No. NA80RAD00060.

Descriptors: *Water pollution, *Water pollution sources, *Oil spills, *Fate of pollutants, Oil slicks, Oil tankers, Oil wells, Oil pollution, Marine environment.

The results of scientific investigations of some of the major oil spills of the past are analyzed to determine the level of our quantitative understanding of oil dispersal and reaction pathways. The case histories that are analyzed include the Santa Barbara and IXTOC I blowouts, and the spills from the Arrow, Argo Merchant, Tsesis, and Amoco Cadiz. In all the cases analyzed, a maximum of 50% of the oil lost can be accounted for. The type of oil and the extent of physical mixing are probably the prime determinants of the quantity of oil that mixes into the water column. Oil deposition in subtidal sediments ranged from 0.1 to 8% of the total. Sediment type and currents influence oil deposition and persistence. Oil stranding on shoreline varied from none (Argo Merchant) to 28% (Amoco Cadiz). Microbial degradation varied greatly, ranging from minimal at the IXTOC I site,

to very significant (possibly 4.5% in the first weeks alone) at Amoco Cadiz. (Halterman-PTT)
W88-03986

ALTERNATIVE MANAGEMENT OPTIONS FOR THE CONTROL OF DIFFUSE PHOSPHORUS LOADS TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5G.
W88-03987

WATER QUALITY ASSESSMENT: A SCREENING PROCEDURE FOR TOXIC AND CONVENTIONAL POLLUTANTS; PART 3,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 2H.
W88-03992

NATURAL ENRICHMENT OF ARSENIC IN LOCH LOMOND SEDIMENTS,
Glasgow Univ. (Scotland). Dept. of Forensic Medicine and Science.
For primary bibliographic entry see Field 2K.
W88-03993

LEGIONELLA PNEUMOPHILA IN A HOSPITAL WATER SYSTEM FOLLOWING A NOSOCOMIAL OUTBREAK: PREVALENCE, MONOCLONAL ANTIBODY SUBGROUPING AND EFFECT OF CONTROL MEASURES,
University Hospital of Wales, Cardiff. Public Health Lab.
For primary bibliographic entry see Field 5F.
W88-03994

COMPARATIVE STUDY OF STRAINS OF SALMONELLA ISOLATED FROM IRRIGATION WATERS, VEGETABLES AND HUMAN INFECTIONS,
Granada Univ. (Spain). Dept. of Food Science, Toxicologyand Applied Chemical Analysis.
B. Garcia-Villanova Ruiz, A. Cueto Espinar, and M. J. Bolanos Carmona.
Epidemiology and Infection, Vol. 98, No. 3, p 271-276, June 1987. 3 tab, 19 ref.

Descriptors: *Pollutant identification, *Human diseases, *Irrigation water, *Vegetable crops, Water quality, Monitoring, Fate of pollutants, Public health, Salmonella, Microbiological studies.

A total of 181 samples of irrigation water from the farmlands of Granada was examined for the presence of Salmonella spp. At the same time 849 samples of the crops from these farmlands and of vegetables sold in city market-places were studied. Sampling was done regularly over the period of study which ran from March 1981 to February 1983. Isolates from these sources were compared with 93 salmonellas isolated from human pathological material at various hospitals of the city of Granada from 1979-80, and again from 1981-3. The most commonly isolated serotypes of human origin were S. typhimurium and S. enteritidis. In irrigation waters and in crops, S. typhimurium, S. kapemba, S. london and S. blockley were the most common. The results indicate a close relationship between the isolates from the irrigation waters and those from the vegetables, but their relationship to prevalent human infections is less clear. (Author's abstract)
W88-03995

OCCURRENCE OF MULTIPLE ANTIBIOTIC RESISTANCE AND R-PLASMIDS IN GRAM-NEGATIVE BACTERIA ISOLATED FROM FAECALLY CONTAMINATED FRESH-WATER STREAMS IN HONG KONG,
Chinese Univ. of Hong Kong, Shatin. Dept. of Microbiology.
G. L. French, J. Ling, K. L. Chow, and K. K. Mark.
Epidemiology and Infection, Vol. 98, No. 3, p 285-299, June 1987. 2 fig, 7 tab, 31 ref.

Descriptors: *Water quality, *Bacteria, *Hong Kong, *Human diseases, *Pollutant identification, *Antibiotics, Microbiological studies, Bacterial analysis.

The bacterial populations of six freshwater streams in populated areas of the Hong Kong New Territories were studied. There is considerable fecal contamination of these streams, with coliform counts as high as 100,000 c.f.u./ml and the contaminating organisms show a high prevalence of antibiotic resistance and multiple resistance. With direct plating of water samples onto antibiotic-containing media, an average of 49% of the gram-negative bacteria were ampicillin-resistant, 3% chloramphenicol-resistant and 1% gentamicin-resistant. At individual sites resistance to these three drugs was as high as 98%, 8% and 3% respectively. More than 70% of strains were resistant to two or more antibiotics, 29% to five or more and 2% to eight or more. A total of 98 patterns of antibiotic resistance were detected with no one pattern predominanting. Twenty-eight gram-negative bacterial species were identified as stream contaminants. Escherichia coli was the commonest bacterial species isolated and other frequent isolates were Enterobacter sp., Klebsiella sp. and Citrobacter sp., but no enteric pathogens were detected. The greatest prevalence of resistance and multiple resistance was associated with the heaviest contamination by E. coli. Analysis of selected stream isolates revealed multiple plasmid bands arranged in many different patterns, but multiple antibiotic resistances were shown to be commonly mediated by single transferable plasmids. Fecally contaminated freshwater streams in Hong Kong may be reservoirs of antibiotic resistance plasmids for clinically-important bacteria. (Author's abstract)
W88-03996

BACTERIOLOGY OF THE FRESHWATER ENVIRONMENT: IMPLICATIONS FOR CLINICAL THERAPY,
Vanderbilt Univ., Nashville, TN. School of Medicine.
P. S. Auerbach, D. M. Yajko, P. S. Nassos, K. W. Kizer, and J. A. Morris.
Annals of Emergency Medicine AEMED3, Vol. 16, No. 9, p 1016-1022, September 1987. 3 fig, 1 tab, 54 ref.

Descriptors: *Aquatic bacteriology, *Bacteriology, *Aquatic environment, *Bacterial analysis, *Microbiological studies, *Water treatment, Water quality control, Public health, Water quality, Disinfection.

Water and animal tissue samples were obtained from sources in Tennessee, California, and Florida. Purified bacterial colonies were isolated and organisms identified. Fifty-eight isolates were recovered. Twenty-seven Gram-negative isolates were identified. Gram-positive organisms were of the coryneform group of Bacillus species. Antibiotic susceptibility testing showed that Aeromonas species were relatively resistant to a wide variety of antimicrobials, which included trimethoprim, cefazolin, and ampicillin. Antibiotics effective against more than 90% of Gram-negative isolates included ciprofloxacin, imipenem, ceftazidime, and trimethoprim-sulfamethoxazole. Freshwater Gram-positive organisms did not display any unexpected susceptibility features. Recommendations for treatment are based on sensitivity in culture and the potentially serious nature of infections caused by Aeromonas species. (Author's abstract)
W88-03997

UNDERSEEPAGE AT THE LOY YANG SETTLING POND DAM,
State Electricity Commission of Victoria, Melbourne (Australia).
For primary bibliographic entry see Field 8B.
W88-04000

CONTAMINATED FOOD AND UPTAKE OF HEAVY METALS BY FISH: A REVIEW AND A PROPOSAL FOR FURTHER RESEARCH,
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
R. Dallinger, F. Prosi, H. Segner, and H. Back.
Oecologia OECOBX, Vol. 73, No. 1, p 91-98, August 1987. 4 tab, 142 ref. Fonds zur Forderung der Wissenschaftlichen Forschung in Osterreich Projects No. P5962B and S-35/04.

Descriptors: *Path of pollutants, *Heavy metals, *Fish, *Food chains, Bioaccumulation, Aquatic ecosystems, Public health.

The uptake of heavy metals via the alimentary tract can be an important factor for the metal budget of fish. Concepts such as biomagnification, bioaccumulation, biotransference, or concentration factors, convey little information about the real threat originating from heavy metals in an aquatic food chain. In polluted aquatic ecosystems the transfer of metals through food chains can be high enough to bring about harmful concentrations in the tissues of fish. This relationship is called the food chain effect. Two kinds of ecological factors influence the food chain effect: first, high levels of contamination of the food and second, the reduction of species diversity. When susceptible species are eliminated, metal-tolerant food organisms may become dominant. Their tolerance may be based either on their ability to accumulate excessive amounts of metals or to exclude heavy metals from the tissues. These two strategies represent feedback mechanisms which may enhance or weaken the food chain effect. It is concluded that future investigations on transference of heavy metals to fish must take into more careful consideration the specific ecological situation of a given environment. (Author's abstract)
W88-04011

RELATIVE IMPORTANCE OF ACIDITY SOURCES FOR HUMIC LAKES IN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
D. F. Brakke, A. Henriksen, and S. A. Norton.
Nature NATUAS, Vol. 329, No. 6138, p 432-434, October 1, 1987. 1 fig, 2 tab, 25 ref.

Descriptors: *Humic matter, *Norway, *Acidic waters, *Acid rain, *Water pollution sources, Hydrogen ion concentration, Lake morphology, Sulfates, Acidity, Organic acids.

The possible role of natural processes contributing to lake acidification and the occurrence of acidic lakes (pH<5) has received considerable attention, but there has been no direct test of the importance of some of the postulated natural processes in Scandinavia where large numbers of acidic lakes occur. Some authors have argued that lakes were acidic simply because of processes occurring in acid soils, and that the effects of acidic precipitation on these lakes were thereby overestimated. An analysis is presented of the role of strong and weak acids in the acidity status of moderately humic lakes (total organic carbon (TOC) 2-15 mg/L) in two areas of Norway. The two areas received precipitation with differing acidity and amounts of sulfate. The data suggest contributions by organic acids to acidity, but strong acids associated with sulfate further reduce the pH and explain the recent acidification of colored lakes in southern Norway. (Author's abstract)
W88-04013

CHEMICAL PROCESSES GOVERNING SOIL AND WATER ACIDIFICATION,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
J. O. Reuss, B. J. Cosby, and R. F. Wright.
Nature NATUAS, Vol. 329, No. 6134, p 27-32, September 3, 1987. 7 fig, 56 ref.

Descriptors: *Acid rain, *Chemical reactions, *Path of pollutants, *Acidity, *Soil contamination, *Water pollution sources, Hydrogen ion concentration, Alkalinity, Cation exchange.

Key soil processes in concert with inputs of strong acids from the atmosphere explain the observed trends in soil and water acidification in North America and Europe. The apparent paradox of waters with pH>5.5 draining acidic soils in pristine areas not receiving significant acid deposition is readily understood as the result of the simultaneous effect of inorganic carbon equilibria, cation exchange, inorganic aluminum equilibria and

chemical weathering. These are well-known and important components in soil solution chemistry; it is their simultaneous interaction that results in the apparent paradox. The elevated P sub CO2 in soils results in acidic soil solution with positive alkalinity; upon emerging as streamwater degassing occurs and pH increases. The result is pH>5.5 waters draining acidic soils found in such areas as Alaska, northern Canada, northern Norway and northern Sweden. These equilibria and flux relationships also explain a second apparent paradox. Acidic soils contain exchangeable H(+) and Al(3+) in amounts equivalent to thousands of years of acid deposition; yet acid deposition to such soils causes acidification of runoff with subsequent loss of fish and other biological effects. In the absence of mobile strong acid anions the enormous store of acid in such soils seldom results in the acidification of freshwaters to the stage at which alkalinity becomes negative; H(+) and inorganic Al(3+) are not mobilized to levels toxic to fish. Addition of relatively small amounts of strong acids to such acid soils, however, can have a major effect on the acidity and concentration of inorganic Al in runoff. Mobile strong acid anions such as SO4(2-) and NO3(-) readily transport H(+) and Al(3+) out of the soil. (Lantz-PTT)
W88-04014

RATE OF ACIDIFICATION OF AQUATIC ECOSYSTEMS IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, R. A. Reid, and E. Grosbois.
Nature NATUAS, Vol. 329, No. 6134, p 45-48, September 3, 1987. 4 fig, 2 tab, 23 ref.

Descriptors: *Acid rain, *Acidification, *Water pollution effects, *Aquatic environment, *Ontario, *Acidic waters, Path of pollutants, Ecosystems, Streams, Alkalinity, Hydrogen ion concentration.

Although the acidification of lakes and streams in several parts of the world as a consequence of the emission and deposition of S and N oxides is well-documented, no direct measurement by continuous monitoring of acidification rate of any lake has been reported. In many cases, historical data have been compared to recent data and acidification of aquatic systems, generally over periods of decades, demonstrated. But methodological changes have always compromised the results. In other cases, historical chemical conditions of lakes and streams have been inferred from either geochemical relationships or from paleolimnological records and compared to current conditions. Here the first direct observations of the acidification rate of a lake that has undergone extensive damage to its aquatic biota as the result of deposition of acids of anthropogenic origin are presented. A threefold decrease in alkalinity and a decrease of 0.2 pH units occurred in the lake despite a reduction in the deposition rate of strong acids over the period of study. Acidification was accompanied by a decrease in base cation content in the lake but not an increase in strong acid anion (SO4(2-)) concentration, indicating that there has probably been a depletion of available cations in the lake's catchment. (Author's abstract)
W88-04015

RAPID REMOVAL OF CHERNOBYL FALLOUT FROM MEDITERRANEAN SURFACE WATERS BY BIOLOGICAL ACTIVITY,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
S. W. Fowler, P. Buat-Menard, Y. Yokoyama, S. Ballestra, and E. Holm.
Nature NATUAS, Vol. 329, No. 6134, p 56-58, September 3, 1987. 4 tab, 29 ref.

Descriptors: *Path of pollutants, *Mediterranean Sea, *Chernobyl, *Zooplankton, Radioactive wastes, Cesium radioisotopes, Radionuclides.

The sinking of particulate organic matter from the euphotic zone is an important pathway for the vertical transport of many elements and organic compounds in the sea. Many natural and artificial radionuclides in surface waters are readily adsorbed onto suspended particles and are presumably scavenged and removed to depth on time scales commensurate with both particle sinking rate and retention time of the radionuclide on the particle. Previously, abyssal benthic organisms from the northeast Pacific were found to contain short-lived fission products which entered the sea surface as fallout from nuclear testing. The presence of these radionuclides at great depth could not be explained by Stokesian settling of small fallout particles and it was hypothesized that zooplankton grazing in the surface layers packaged these particle-reactive radionuclides into large, relatively dense fecal pellets which rapidly sank to depth. Data are reported here from a time-series sediment trap experiment, and concomitant zooplankton collections, which show conclusively that Chernobyl radioactivity, in particular the rare earth nuclides 141-Ce and 144-Ce, entering the Mediterranean as a single pulse, was rapidly removed from surface waters and transported to 200 m in a few days primarily by zooplankton grazing. (Author's abstract)
W88-04016

AQUATIC MICROBIAL ACTIVITY AND MACROFAUNAL PROFILES OF AN OKLAHOMA STREAM,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
G. A. Burton, and G. R. Lanza.
Water Research WATRAG, Vol. 21, No. 10, p 1173-1182, October 1987. 10 fig, 3 tab, 39 ref.

Descriptors: *Streams, *Aquatic environment, *Toxicity, *Macrofauna, *Water quality, Microbial degradation, Oklahoma, Microbiological studies, Enzymes, Plankton, Monitoring, Electron transport, Bioassays.

A toxicity assessment was conducted on Skeleton Creek, near Enid, Oklahoma. This creek received effluents from an oil refinery, municipal waste treatment facility, and a fertilizer processing plant. Microbial activity assays, which focused on sediments, include: dehydrogenase, alkaline phosphatase, glucosidase, amylase and protease activity. Microbial electron transport system activity was also measured in overlying waters and sediments. Results were compared to a study conducted at the same time by the U.S. EPA which measured instream fish, plankton and benthic communities. In addition, EPA conducted 7-day Ceriodaphnia reproductive toxicity tests and 7-day larval fathead minnow growth tests. Effects occurred below the 3 discharges and similar response patterns were noted between surrogate microbial assays and stream communities. These results highlight the importance and feasibility of multi-tiered test schemes in aquatic toxicity assessments. (Author's abstract)
W88-04019

DETERMINANTS OF THE MICROBIOLOGICAL CHARACTERISTICS OF SPA POOLS IN SOUTH AUSTRALIA,
South Australian Health Commission, Adelaide.
A. Esterman, I. Calder, C. Cameron, D. Roder, and R. Walters.
Water Research WATRAG, Vol. 21, No. 10, p 1231-1235, October 1987. 6 tab, 23 ref.

Descriptors: *Water quality control, *Water quality, *Microbiological studies, *Spa pools, *Australia, Pseudomonas aeruginosa, Monitoring, Amoebae, Cyanuric acid, Chlorine, Disinfection.

The microbiological quality of 49 South Australian spa pools was assessed, using as criteria the presence or absence of Pseudomonas aeruginosa, the colony count, and the presence or absence of amoebae. Chlorine was the disinfectant most frequently used (with or without cyanuric acid), followed by bromine. The microbiological quality of water samples did not vary by disinfectant mode, except of samples from pools using cyanuric acid which gave poorer results for amoebae. Where chlorine alone was used for disinfection, results indicate that a free chlorine residual of at least 4 mg/L is necessary to be 95% sure of acceptable microbiological quality. (Author's abstract)
W88-04026

MICROBIAL DEGRADATION OF NITRILOTRIACETATE (NTA) DURING RIVER WATER/GROUNDWATER INFILTRATION: LABORATORY COLUMN STUDIES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
E. Kuhn, M. Van Loosdrecht, W. Giger, and R. P. Schwarzenbach.
Water Research WATRAG, Vol. 21, No. 10, p 1237-1248, October 1987. 10 fig, 29 ref. Swiss National Science Foundation Project No. 3,944-0.84.

Descriptors: *Biodegradation, *Nitrilotriacetate, *Path of pollutants, *Infiltration, *Surface-groundwater relations, *Microbial degradation, *Fate of pollutants, Groundwater, Rivers, Aquifers, Groundwater quality.

In laboratory column experiments with aquifer material collected from a natural river water/groundwater infiltration site, the effects of changes in NTA concentration (0.06-3.40 micrometers), temperature (5-20 C), and redox conditions on the microbial degradation of NTA during infiltration have been investigated. Under both aerobic and denitrifying conditions, NTA was rapidly mineralized and supported microbial growth as a sole carbon and energy source. The presence of other degradable organic compounds and of trace metals had no significant effect on the total rate of NTA elimination after a 21.8 cm flow distance. At concentrations between 0.02 and 0.05 micrometers, NTA degradation was still rapid (apparent pseudo first-order rate constants of up to 15/day). From the results of the column experiments it may be concluded that under environmental conditions typical for Switzerland, very low residual NTA concentrations (< 0.01 micrometers) should be present at all times of the year in the groundwater after only a few meters of infiltration, even when concentrations of NTA in river water reach 3-4 micrometers. This conclusion is corroborated by results of field measurements. (Author's abstract)
W88-04027

OBSERVATIONS OF THE PREFERENTIAL LOSS OF MAJOR IONS FROM MELTING SNOW AND LABORATORY ICE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W88-04032

TRACE METALS: CD, CU, PB AND ZN IN GELATINOUS MACROPLANKTON FROM THE NORTHWESTERN MEDITERRANEAN,
Institut National de la Sante et de la Recherche Medicale, Paris (France).
For primary bibliographic entry see Field 5A.
W88-04033

SPATIAL VARIABILITY OF SOIL SALINITY IN FURROW-IRRIGATED TORRIFLUVENTS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 3C.
W88-04043

DBCP, EDB, AND TCP CONTAMINATION OF GROUND WATER IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
D. S. Oki, and T. W. Giambelluca.
Ground Water GRWAAR, Vol. 25, No. 6, p 693-702, November-December 1987. 13 fig, 3 tab, 25 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Hawaii, *Pesticides, Organic compounds, DBCP, EDB, TCP, Pesticides, Fate of pollutants, Groundwater quality, Wells.

In recent years, several pesticide-related contaminants have been detected in the groundwaters of the State of Hawaii. Two soil fumigants previously used by pineapple growers, 1,2-dibromo-3-chloro-

propane (DBCCP) and 1,2-dibromoethane or ethylene dibromide (EDB), have been detected in several wells on Oahu and Maui. An impurity of the soil fumigant DD,1,2,3-trichloropropane (TCP), also has been detected in a number of wells. DBCP, EDB, and TCP are of particular concern to State public health officials due to known and possible unknown health effects associated with these compounds. The locations of the contaminated well sites on Oahu appear to be correlated with the areas of past and present pineapple cultivation when the ambient groundwater flow pattern is taken into consideration. In addition, several large fuel pipeline leaks are located in the vicinity of the EDB contamination. In general, TCP contamination is more widespread than either DBCP or EDB contamination. TCP levels appear to be declining in Oahu water wells while EDB levels in the contaminated portion of southern Oahu appear to be increasing. The direction of temporal trends in DBCP concentration at present varies according to site. (Author's abstract)
W88-04061

HORIZONTAL PLANE SOURCE MODEL FOR GROUND-WATER TRANSPORT,
ERT, A Resource Engineering Co., Concord, MA.
D. P. Galya.
Ground Water GRWAAR, Vol. 25, No. 6, p 733-739, November-December 1987. 4 fig, 10 ref, append.

Descriptors: *Groundwater movement, *Path of pollutants, *Horizontal planes, Simulation analysis, Mathematical models.

A model was derived through the use of Green's functions to simulate three-dimensional contaminant transport from a horizontal plane source (NPS). This analytical model incorporates retardation and decay, and can simulate varying source emission rates. Appropriate uses of the model include simulations of contaminant transport from landfills, waste lagoons, land treatment facilities, and areas of pesticide application. Comparison between HPS and point source solutions indicates that for such simulations, the HPS model will provide more accurate results than the point source solution, particularly near the source. Representative model applications indicate the model's sensitivity to variations in retardation, decay, and temporal period of source emission. (Author's abstract)
W88-04066

WATER QUALITY MODELING USING PERSONAL COMPUTERS,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W. S. Lung.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 909-913, October 1987. 2 tab, 17 ref.

Descriptors: *Computer models, *Computers, *Simulation analysis, *Path of pollutants, *Water quality control, Fate of pollutants, Water quality, Model studies, Biological oxygen demand, Dissolved oxygen, Estuaries, Streams, Lakes.

A number of water quality models for streams, rivers, lakes, and estuaries have been efficiently used to perform water quality simulations on personal computers. In light of increasing water quality model use in wasteload allocations and National Pollutant Discharge Elimination System permit related modeling studies, efficient operations mean that analysts could spend most of the time reviewing and understanding the model results instead of processing the results of analysis. Therefore, personal computers now offer a cost-effective alternative to mainframes in water quality modeling. The new 80386-based computers would make this alternative even more attractive because they offer minicomputer capability. The capability of a well configured personal computer systems can do for water quality modeling is demonstrated. First, applications are presented which range from simple steady-state biochemical oxygen demand-dissolved oxygen (BOD-DO) modeling of streams and estuaries, estuarine eutrophication modeling, to highly complicated time-variable modeling of lakes and estuaries. These provide a good perspective on the use of personal computer systems for water quality modeling. Second, hardware and software used for these applications are discussed. There are > 200 different brands of personal computers. Most of them use similar processors such as 8088, 8086, or 80286 as the central processing unit. Discussions focus on the machines which are commonly used in engineering work and in water quality modeling in particular. It is demonstrated that with proper hardware and software, using these computer systems for water quality modeling is not only practical but also economical. (Lantz-PTT)
W88-04075

ENVIRONMENTAL CONTAMINATION BY POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS ASSOCIATED WITH PULP AND PAPER MILL DISCHARGE,
Environmental Research Lab.-Duluth, MN.
D. W. Kuehl, B. C. Butterworth, W. M. DeVita, and C. P. Sauer.
Biomedical and Environmental Mass Spectrometry BMSYAL, Vol. 14, No. 8, p 443-447, August 1987. 3 fig, 3 tab, 7 ref.

Descriptors: *Pulp wastes, *Dioxin, *Fish, *Tissue analysis, *Fate of pollutants, *Path of pollutants, Fluvial sediments, Industrial wastes, Pollutant identification, Gas chromatography, Environmental effects, Quality control, Sludge, Water pollution sources, Fly ash, Carp, Chemical analysis, Bioaccumulation.

Sludge from seven pulp and paper mills, fish from the Petenwell Reservoir, and Wisconsin River sediments were analyzed for 2,3,7,8-TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin). The level of contamination ranged from not detectable (1 picogram/gram) to over over 400 picograms/gram. Analyses for other planar polychlorinated contaminants indicated high levels of contamination by other polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Polychlorinated xanthenes and xanthones were identified as potential interferences in the gas chromatography/mass spectrometry analysis. The bioavailability of PCDDs and PCDFs from other solid matrices including municipal incinerator fly ash and contaminated river sediment to freshwater fish were also studied. Results from the exposure of carp to municipal incinerator fly ash indicated that the Bioavailability Index (BI) of select 2,3,7,8-substituted isomers, the biosignificant isomers, decreased with an increasing degree of chlorination. The BI was nearly the same for PCDDs and PCDFs with similar chlorine substitution patterns at the same degree of chlorination. The BIs calculated from PCDD and PCDF concentrations in sediment and fish from the Petenwell Reservoir of the Wisconsin River showed a similar trend of decreasing BI with increasing degree of chlorination for PCDDs. (Geiger-PTT)
W88-04078

BACTERIOLOGICAL CHARACTERISTICS OF 15 FRESHWATER BEACHES IN MANITOBA,
Cadham Provincial Lab., Winnipeg (Manitoba).
L. Sekla, D. Williamson, C. Greensmith, G. Balacko, and D. Brown.
Canadian Journal of Public Health CJPEA4, Vol. 78, No. 3, p 181-184, May-June, 1987. 2 tab, 11 ref.

Descriptors: *Water quality, *Coliforms, *Manitoba, *Bioindicators, *Beaches, Bacteria, Public health, Escherichia coli, Monitoring, Pollutant identification, Water pollution effects, Enteric bacteria, Swimming, Infection, Lakes, Recreation, Regulations.

During the summers of 1984 and 1985, a total of 6680 samples of lake water were collected from 15 of the most popular beaches in Manitoba and tested for fecal coliforms, enterococci and Escherichia coli. The 30 day maximum geometric mean of 200 fecal coliforms per 100 ml of water recommended as the acceptable maximum limit in the 1983 Guidelines for Canadian Recreational Water for bather protection was achieved by beaches in all three geographic regions. The United States Environmental Protection Agency (USEPA) criterion of 126 Escherichia coli per 100 ml of water was satisfied by the beaches on the west side of Lake Winnipeg. The USEPA criterion of 33 enterococci per 100 ml, as well as the enterococcus criteria proposed for Manitoba were not met by most beaches in all three regions. Before recommending changes to the national guidelines for recreational water quality (i.e. adding enterococci criteria), it is important to document an association between illness and counts of a specific indicator bacteria, standardize the test procedures for this bacteria, and to agree on the bacterial counts that would relate to an acceptable risk to bathers. (Author's abstract)
W88-04079

DISTRIBUTION OF INDICATOR BACTERIA AND VIBRIO PARAHAEMOLYTICUS IN SEWAGE-POLLUTED INTERTIDAL SEDIMENTS,
Massachusetts Univ. at Boston. Dept. of Biology.
M. P. Shiaris, A. C. Rex, G. W. Pettibone, K. Keay, and P. McManus.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 8, p 1756-1761, August 1987. 2 fig, 4 tab, 19 ref. National Institutes of Health, Biomedical Research Support Grant S.O. 7RR07199-04.

Descriptors: *Bioindicators, *Vibrio, *Marine sediments, *Boston Harbor, *Path of pollutants, *Coliforms, Water pollution effects, Spatial distribution, Combined sewers, Enteric bacteria, Viruses, Pollution load, Mud flats, Regression analysis, Organic carbon, Water pollution sources, Sediment contaminations, Wastewater disposal, Microbiological studies.

The impact of a sewage point source on the bacterial densities in an intertidal mud flat in Boston Harbor, Massachusetts, was investigated. The area, Savin Hill Cove, acts as a receiving basin for a combined storm and sewage outlet (CSO). Preliminary examination of sediments and overlying water at high tide demonstrated that fecal coliforms were present in sediments at abundances 2 to 4 orders of magnitude higher than in the overlying water column. The following bacterial counts were determined from sediments along a sampling transect extending 460 m from the CSO: total bacteria by epifluorescent microscopy, heterotrophic bacteria by plate counts on nutrient-rich and nutrient-poor media, fecal coliforms and enterococci by membrane filtration, and Vibrio parahaemolyticus by a most probable-number technique with a resuscitation step. Median sediment grain size, average tidal exposure, carbon/nitrogen ratio, and total organic carbon were also measured. All bacterial indices, except for V. parahaemolyticus, declined significantly with distance from the outfall. Multiple regression analysis indicated that tidal exposure (low tides) may affect densities of total bacteria. Fecal coliforms and enterococci were still present in appreciable numbers in sediments as far as 460 m away from the CSO. In contrast, V. parahaemolyticus densities did not correlate with the other bacterial counts nor with any of the environmental parameters examined. These results indicate that intertidal sediments which adjoin point sources of pollution are severely contaminated and should be considered as potentially hazardous reservoirs of sewage-born diseases. (Author's abstract)
W88-04081

SURVIVAL OF CANDIDA ALBICANS IN TROPICAL MARINE AND FRESH WATERS,
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
L. Valdes-Collaza, A. J. Schultz, and T. C. Hazen.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 8, p 1762-1767, August 1987. 5 fig, 2 tab, 32 ref. Public Health Service Grants RR-8102 and RR-2657.

Descriptors: *Candida albicans, *Fate of pollutants, *Yeasts, *Escherichia coli, *Coastal waters, *Puerto Rico, *Rain forests, Water quality, Coliforms, Industrial wastes, Bioindicators, Organic

loading, Tropical regions, Water pollution sources, Path of pollutants, Public health.

A survey of Candida albicans indicated that the organism was present at all sites sampled in a rain forest stream and in near-shore coastal waters of Puerto Rico. In the rain forest watershed no relationship existed between densities of fecal coliforms and densities of C. albicans. At two pristine sites in the rain forest watershed both C. albicans and Escherichia coli survived in diffusion chambers for extended periods of time. In near-shore coastal waters C. albicans and E. coli survival times in diffusion chambers were enhanced by effluent from a rum distillery. The rum distillery effluent had a greater effect on E. coli than on C. albicans survival in the diffusion chambers. These studies show that neither E. coli nor C. albicans organisms are good indicators of recent fecal contamination in tropical waters. It further demonstrates that pristine freshwater environments and marine waters receiving organic loading in the tropics can support densities of C. albicans which may be a health hazard. (Author's abstract)
W88-04082

ALKALINE APPROACH TO TREATING COOLING TOWERS FOR CONTROL OF LEGIONELLA PNEUMOPHILA,
Pittsburgh City Water Dept. PA.
For primary bibliographic entry see Field 5G.
W88-04083

INFECTIVITY AND ANTIGENICITY REDUCTION RATES OF HUMAN ROTAVIRUS STRAIN WA IN FRESH WATERS,
Georgia Univ., Athens. Dept. of Food Science and Technology.
O. C. Pancorbo, B. G. Evanshen, W. F. Campbell, S. Lambert, and S. K. Curtis.
Applied and Envrionmental Microbiology AEMIDF, Vol. 53, No. 8, p 1803-1811, August 1987. 7 fig, 2 tab, 39 ref.

Descriptors: *Viruses, *Chlorination, *Fate of pollutants, *Hydrogen ion concentration, *Microbiological studies, *Infection, Wastewater, Models, Human diseases, Path of pollutants, Water pollution effects, Groundwater, Assay, Lakes, Drinking water, Bioassays.

The rates of inactivation of human rotavirus type 2 (strain Wa) (HRV-Wa) and poliovirus type 1 (strain CHAT) were compared in polluted waters (creek water and secondary effluent before chlorination) and nonpolluted waters (lake water, groundwater, and chlorinated tap water). Viral infectivity titers were determined by plaque assays, while HRV-Wa antigenicity also was monitored by an enzyme-linked immunosorbent assay. Both viruses persisted longest in lake water and shortest in tap water. The actual inactivation times (i.e., times required for two-log base 10 reductions of initial viral titers) for the two viruses were significantly different in all waters except tap water. With the exception of the groundwater and secondary effluent results, the HRV-Wa inactivation times in the fresh waters were significantly different. Owing perhaps to aggregation, HRV-Wa appeared less susceptible to the effects of chlorine than previously reported for this virus and for the simian rotavirus SA11. HRV-Wa displayed prolonged survival in lake water and groundwater exceeding that previously reported for the SA11 virus. The HRV-Wa infectivity reduction rate (ki) was significantly correlated with the water pH (i.e., as pH increased, ki increased). The water pH may have influenced viral aggregation and thereby HRV-Wa susceptibility to other virucidal factors in the water. Enzyme-linked immunosorbent assay results showed similar inactivation patterns with the most significant reduction in HRV-Wa antigenicity occurring in polluted waters and tap water. In all waters, particularly tap water, infectivity declined at a faster rate than antigenicity. It is proposed that HRV-Wa can be used as a model for future studies of rotaviral persistence in the aquatic environment. (Author's abstract)
W88-04084

STATUS OF GROUNDWATER POLLUTION IN THE SAN GABRIEL VALLEY, CALIFORNIA,
J. D. Earley.
Journal of Environmental Health JEVHAH, Vol. 50, No. 1, p 33-34, July-August, 1987. 1 fig, 6 ref.

Descriptors: *Groundwater pollution, *California, *Public health, Water pollution prevention, *Water pollution sources, *Organic compounds, *Path of pollutants, Drinking water, Water pollution effects, Aquifers, Chlorinated hydrocarbons, Industrial wastes, Carbon filters, Leaching, Carbon tetrachloride, Trichloroethylene, Perchloroethylene.

Contamination of groundwater in the San Gabriel Valley of California has been identified as a potential health hazard from industrial sources. Volatile organic chemicals deposited into the ground at the BKK landfill, the Monterey Park dump, and other illegal dump sites are slowly moving towards the San Gabriel Valley aquifer. An expanded sampling program for the entire San Gabriel Basin and outlying areas was implemented by the California Department of Health Services and the Los Angeles County Department of Health Services. To date, the sampling program has identified 59 wells that are contaminated by trichloroethylene (TCE), perchloroethylene (PCE), or carbon tetrachloride (CTC). Contaminated wells were taken out of service and industries suspected of improper practices were identified and mailed letters by the EPA. It is anticipated that the response to these letters will provide insight into the use and disposal of chlorinated solvents by industries in the San Gabriel Basin. To reduce the level of volatile organic compounds in the drinking water in the San Gabriel Valley, the following methods are being used: aeration, carbon filtration, blending, recommending bottled water for drinking purposes, and purchasing water which meets the standards from the Metropolitan Water District. (Geiger-PTT)
W88-04093

RADIOACTIVE CESIUM FROM THE CHERNOBYL ACCIDENT IN THE GREENLAND ICE SHEET,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
C. I. Davidson, J. R. Harrington, M. J. Stephenson, M. C. Monaghan, and J. Pudykiewicz.
Science SCIEAS, Vol. 237, No. 4815, p 633-634, August 7, 1987. 1 fig, 19 ref. National Science Foundation Grants DPP-8315452 and DPP-8618223.

Descriptors: *Cesium radioisotopes, *Greenland, *Snow accumulation, *Chernobyl, *Nuclear explosions, Radioactivity techniques, Path of pollutants, Air pollution, Nuclear reactors, Nuclear powerplants, Arctic, Glaciers, Models, Radioactive wastes, Fate of pollutants.

Measurements of Cs-134 and Cs-137 in Greenland snow together with models of long-range transport have been used to assess radionuclide deposition in the Arctic after the Chernobyl Nuclear Powerplant accident. Samples were collected from a snowpit 23 km southwest of Dye 3, Greenland, in late July 1986. Snowpit walls were sampled in continuous adjacent layers to a depth of 1.5 m under strict contamination control. The density was measured in each 5-cm layer, and the presence of ice strata and other distinguishing characteristics was recorded. These findings combined with results from delta-18-Oxygen analyses suggest that a well-defined layer of radioactive cesium is now present in polar glaciers, providing a new reference for estimating snow accumulation rates and dating ice core samles. (Geiger-PTT)
W88-04094

BENZTHIAZOLES IN ESTUARINE SEDIMENTS AS INDICATORS OF STREET RUNOFF,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
R. B. Spies, B. D. Andresen, and D. W. Rice.
Nature NATUAS, Vol. 327, No. 6124, p 697-699, June 25, 1987. 4 fig, 1 tab, 12 ref.

Descriptors: *Urban runoff, *Marine sediments, *Path of pollutants, *Water pollution sources, *Pollutant identification, Roads, Indicators, Sulfur compounds, Aromatic compounds, Coastal waters, Rubber, Mass spectrometry, Highways.

Street runoff can be a major source of potentially toxic aromatic compounds that enter estuaries, embayments and ocean inlets. While contaminated sediments in San Francisco Bay were being investigated, several benzthiazoles were discovered which appear to be derived from the use of antioxidants in the manufacture of rubber tires. Investigations confirmed that two of these compounds, benzthiazole and 2-(4-morpholinyl-benzthiazole), occur in street runoff and that they can result from the weeathering of a commercially used anti-oxidant in rubber manufacture. These compounds are proposed as potential indicators of the contribution of street runoff to the contaminants in sediments of urban coastal areas. (Author's abstract)
W88-04095

TOWN WATER SUPPLY AS THE CAUSE OF AN OUTBREAK OF CAMPYLOBACTER INFECTION,
Department of Health, Christchurch (New Zealand).
M. A. Brieseman.
New Zealand Medical Journal NZMJAX, Vol. 100, No. 812, p 212-213, April, 8 1987. 8 ref.

Descriptors: *Bacteria, *Drinking water, *Epidemics, *New Zealand, *Water pollution sources, Feedlot runoff, Infection, Water pollution effects, Public health, Path of pollutants, Coliforms, Chlorination, Disinfection, Water quality.

An outbreak of campylobacter disease in the borough of Ashburton, Canterbury, New Zealand is recorded. Nineteen cases of campylobacter were reported within a two week period. Although the bacteria is usually associated with animals, epidemiological evidence indicates contamination of the town water supply as the source of infection. Contamination most likely resulted from the heavy rain washing campylobacter from the surrounding beef and sheep farms into the river which serves as a source of drinking water. Chlorination was delayed for a few hours after the commencement of the heavy rain, allowing time for the bacteria to reach drinking water supplies. Fecal contamination of the water supply prior to chlorination was confirmed by high coliform counts. (Geiger-PTT)
W88-04096

COMPARATIVE ABILITIES OF LEAF SURFACES TO NEUTRALIZE ACIDIC RAINDROPS. II. THE INFLUENCE OF LEAF WETTABILITY, LEAF AGE AND RAIN DURATION ON CHANGES IN DROPLET PH AND CHEMISTRY ON LEAF SURFACES,
Toronto Univ. (Ontario). Dept. of Botany.
C. M. Adams, and T. C. Hutchinson.
New Phytologist NEPHAV, Vol. 106, No. 3, p 437-456, July 1987. 5 fig, 5 tab, 46 ref.

Descriptors: *Acid rain, *Vegetable crops, *Neutralization, *Chemistry of precipitation, *Leaves, *Fate of pollutants, Acidic water, Beets, Wettability, Hydrogen ion concentration, Precipitation intensity, Tomatoes, Plant pathology, Comparison studies, Nutrients, Calcium, Potassium, Magnesium, Chemical reactions, Cabbage.

The ability of leaf surfaces of sunflower, radish, cabbage and sugar beet to neutralize acid rains (pH 3.0) of varying duration was examined using sprayings of similated rain of 5, 15, 45, and 90 min durations weekly. Following acidic sprays, the pH of raindrops on leaves was measured at intervals until drops dried. Leaves of cabbage and sugar beet, which had smaller areas of contact with raindrops than those of radish and sunflower, were markedly less able to neutralize acidic droplets. Droplets on the cotyledons of all species had higher pHs than droplets on the true leaves. The duration of rain spraying significantly affected leaf surface neutralization. In 2- and 3-week-old plants, long exposures to rain markedly increased neutral-

ization in comparison with short exposures. In 6-week-old plants, the effect was the reverse; sprays of longer duration significantly decreased foliar neutralization compared with sprays of shorter duration. Significant decreases in both leaf and root dry weights were found for cabbage and sugar beet treated with acid rain for 45 and 90 min. Chemical analysis of raindrops left on foliage for 75 min showed an increase in the concentrations of Ca, Mg, and K ions. The elemental composition of drying droplets collected on 4-week-old plants was not affected by the duration of previous rain exposures. In contrast, the Ca and Mg ion concentrations of drying droplets on 7-week-old plants exposed to 45 and 90 min rains were significantly lower than on those exposed to 5 and 15 min rains. Results from a subsequent experiment using cabbage, radish, broccoli, brussel sprout and tomato, in which droplet pHs were measured over acid rain-induced lesions and over uninjured leaf tissue, showed significantly higher pHs in the droplets over the foliar lesions. (Geiger-PTT)
W88-04097

ASSESSMENT OF A CLASS OF NEYMAN-SCOTT MODELS FOR TEMPORAL RAINFALL,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W88-04109

GASEOUS DEPOSITION TO SNOW. I. EXPERIMENTAL STUDY OF SO2 AND NO2 DEPOSITION,
Arizona Univ., Tucson. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W88-04114

GASEOUS DEPOSITION TO SNOW. II. PHYSICAL-CHEMICAL MODEL FOR SO2 DEPOSITION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2B.
W88-04115

AEROSOL AND GRAPHITIC CARBON CONTENT OF SNOW,
New Mexico State Univ., Las Cruces. Dept. of Physics.
For primary bibliographic entry see Field 2B.
W88-04116

MONITORING TRANSPORT OF SELECTED PESTICIDES AND PHENOLS IN SOIL COLUMNS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5D.
W88-04117

PERSISTENCE CHARACTERISTICS OF OPERATIONALLY SPRAYED FENITROTHION IN NEARBY UNSPRAYED AREAS OF A CONIFER FOREST ECOSYSTEM IN NEW BRUNSWICK,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 4, p 413-438, 1987. 6 tab, 28 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Fenitrothion, *Pesticide residues, *Insecticides, Conifers, Forests, Ecosystems, Pesticides, New Brunswick, Canada, Plant tissues, Gas liquid chromatography.

Persistance characteristics of operationally sprayed insecticide (fenitrothion) were investigated in various substrates sampled from neighboring unsprayed areas in New Brunswick, Canada. Air, water, sediment, aquatic plants, fish, balsam fir (Abies balsamea (L.) Mill) foliage, forest soil and litter samples were collected from random sampling locations selected within 200 m from the operational spray blocks. The same substrates were resampled from the same plots and from the same locations about a year later just prior to the commencement of the operational spraying. Control samples were collected from an unsprayed site near Sault Ste. Marie, Ontario. All samples were analyzed for fenitrothion, by gas-liquid chromatography. With the exception of the fish samples, all the substrates collected during the time of operational spraying contain low but detectable levels of fenitrothion. When collected a year later prior to the operational spraying program, only balsam fir shows any detectable levels (detection limit, 0.01 ppm) of the chemical. All other samples show no fenitrothion residues (detection limit for air, 10 ng/cu m; for water, 0.01 ppb; and for other samples, 0.01 ppm). The findings confirm that fenitrothion does not persist for an extended period of time in aquatic substrates. The conifer foliage, however, shows persistent residues at a level of about 0.55 ppm even after the winter months, although there is no indication of accumulation of the chemical as a result of repeated exposure. It is demonstrated that the conifer needles act as a micro-sink for the chemical which shows a tendency to persist in leaf tissues for a considerable length of time. (Author's abstract)
W88-04118

PROTECTING GROUNDWATER FROM VIRAL CONTAMINATION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5G.
W88-04123

DIFFUSION OF CRUDE OIL IN WATER,
Kuwait Univ., Safat. Coll. of Engineering and Petroleum.
S. E. M. Hamam.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 5, p 445-456, July 1987. 4 fig, 1 tab, 5 ref. Research Council of Kuwait University Grant EC012.

Descriptors: *Oil, *Diffusion coefficient, *Fate of pollutants, *Path of pollutants, *Solubility, *Oil pollution, Mathematical studies, Mathematical equations, Fourier analysis, Diffusion equations, Temperature effects, Industrial wastes, Water temperature.

Adequate knowledge of the diffusion coefficients of oil in water is important for understanding the fate of oil in aquatic environments. The solubility of crude oil of 28 American Petroleum Institute gravity (API), was determined experimentally at 25, 35, and 45 degrees C. Solution of the unsteady-state diffusion equation using Fourier series was used to calculate the diffusion coefficients. The diffusion coefficient as well as the maximum solubility of crude oil increases with an increase in temperature; the derived equations are presented. The activation energy was calculated to be 8.5 kCal which confirms that the dissolution of oil is diffusion controlled. (Wood-PTT)
W88-04126

MUSSELS AS BIOINDICATORS OF PCB POLLUTION: A CASE STUDY ON UPTAKE AND RELEASE OF PCB ISOMERS AND CONGENERS IN GREEN-LIPPED MUSSELS (PERNA VIRIDIS) IN HONG KONG WATERS,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5A.
W88-04128

FATE AND BEHAVIOR OF HERBICIDES, BUTACHLOR, CNP, CHLOMETHOXYNIL, AND SIMETRYNE IN RIVER WATER, SHELLFISH, AND SEDIMENTS OF THE ISHIKARI RIVER,
Hokkaido Inst. of Public Health, Sapporo (Japan).
T. Ohyama, K. Jin, Y. Katoh, Y. Chiba, and K. Inoue.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 4, p 555-562, October 1987. 3 fig, 9 ref.

Descriptors: *Herbicides, *Fate of pollutants, *Path of pollutants, *Bioindicators, *Shellfish, *Ishikari River, *Japan, *Sediment contamination, Pollutant identification, Rivers, Pesticides, Butachlor, CNP, Chlomethoxynil, Simetryne, Water pollution, Correlation analysis, Bottom sediments.

Herbicides applied to rice paddy fields during the May to June planting season flow out with effluent water to contaminate river water and benthic animals in the river. In order to understand the fate and behavior of the herbicides in the aquatic environment of the Ishikari River, the concentrations of four herbicides (butachlor, CNP, chlomethoxynil and simetryne) were examined in the shellfish, river water and river sediments. Samples were taken biweekly from May to August and monthly from September to December 1986. The examination of the shellfish, Corbicula japonica, used as the bioindicator elucidates the amount and range of herbicide contamination in the Ishikari River system. The maximum concentrations of the herbicides except simetryne were observed at the end of May. The maximum levels of CNP, butachlor and chlomethoxynil were 3.0, 0.17 and 0.06 ppm, respectively. This data correlates with the water solubility of the herbicides examined. The herbicide concentrations found in the river-bottom sediments ranged from not detectable to 50 ppb through the sampling period. Unlike the results obtained from shellfish, there is no distinct correlation between the concentration of the herbicides in the sediments and the water solubilities of the compounds. (Wood-PTT)
W88-04130

CORRESPONDENCE BETWEEN URBAN AREAS AND THE CONCENTRATIONS OF CHLORDANE IN FISH FROM THE KANSAS RIVER,
Kansas Dept. of Health and Environment, Topeka. Div. of Environment.
J. A. Arruda, M. S. Cringan, D. Gilliland, S. G. Haslouer, and J. E. Fry.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 4, p 563-570, October 1987. 1 fig, 3 tab, 8 ref.

Descriptors: *Chlordane, *Fish, *Fate of pollutants, *Path of pollutants, *Pesticides, *Water pollution effects, *Kansas River, Fish tissues, Carp, Chlorinated hydrocarbons, Urban areas, Tissue analysis, Bioaccumulation.

Chlordane is one of the few persistent chlorinated hydrocarbon pesticides currently used in quantity and available to the general public. Over 80% of the locations from which samples were taken in Kansas have detectable levels of chlordane in the fish and at over 50% of those locations, the levels of chlordane exceeded the 0.1 milligrama/kilogram (mg/kg) guideline for the protection of predators. The results of a river-wide fish tissue data study are presented and its environmental and human health significance is discussed. Tissues from carp were analyzed and exhibited chlordane concentrations ranging from not detectable to 2.1 mg/kg. Mean chlordane concentration increased at or below each major urban area and then decreased further downstream. Each site with chlordane levels greater than 0.10 mg/kg is located in or below urban areas, but specifically below sewage treatment plant discharges or streams draining urban areas. Since chlordane has a high bioaccumulation factor which is on the order of 10,000, levels below the analytical detection limit could result in significant accumulation in fish tissue. The results using edible portions of the fish suggest that concentrations of chlordane in whole fish exceed those recommended by National Academy of Science/National Academy of Engineering. (Wood-PTT)
W88-04131

VOLATILE HALOCARBON COMPOUNDS IN PROCESS WATER AND PROCESSED FOODS,

Food and Drug Administration, Washington, DC. Contaminants Chemistry Div.
A. D. Uhler, and G. W. Diachenko.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 4, p 601-607, October 1987. 2 tab, 10 ref.

Descriptors: *Halogenated hydrocarbons, *Water pollution sources, *Path of pollutants, *Fate of pollutants, *Food-processing wastes, Industrial wastes, Process water, Food processing industry, Groundwater, Volatility.

Volatile halocarbon compounds (VHCs) of low molecular weight are among the most abundant man-made industrial chemicals in the USA. VHCs have been reported in foods as well as in groundwater leading to the suggestion that food contamination by VHCs may be caused by polluted process waters. Therefore, the possibility of VHC contamination of food through contact with contaminated process waters is investigated and the levels of contamination are ascertained. Process water and foods from processing plants situated in areas of nine different states where contamination of the process water was most probable were collected and analyzed. The industrial plants chosen for investigation were those with the potential of using contaminated municipal water supplies as identified by the EPA Groundwater Supply Survey or those located near hazardous waste dumps where VHCs have been reportedly leaching into groundwater. The processing plants selected also produced high-fat content foods that come into contact with water during processing or produced a product that contained a high percentage of added water. In general, only low levels of VHCs (<<50 ppb) were found in any process waters with the exception of two from Florida whose 60 ppb of chloroform and 14 ppb of bromodichloromethane are recognized byproducts of water chlorination and well under the EPA maximum total trihalomethane limit of 100 ppb. In almost all cases, VHCs detected in process water did not appear in the finished food product at the 1 ppb level or above. Suggested reasons for this observation include lack of significant partitioning into the food in the cases in which food is washed or volatilization loss of the VHCs when water is mixed with the food product. (Wood-PTT)
W88-04132

MUTAGENICITY OF TAMA RIVER SEDIMENTS,

King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences.
S. Oishi, and O. Takahashi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 4, p 696-700, October 1987. 1 fig, 1 tab, 7 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Bacterial mutagenicity, *River sediments, *Tama River, *Japan, *Water pollution effects, Sediments, Pollutant identification, Bottom sediments, Mutagens, Rivers, Estimation, Bacteria, Industrial wastes.

The existence of mutagens in an aquatic environment, though small and variable, is an important problem. Many chemicals from the water are concentrated in river sediments by adsorption and sedimentation and are relatively stable there. It is suggested that the sensitive, economic, and simple bacterial mutagenicity test of crude extract of river sediments be used for the estimation of pollution or toxicity levels in rivers. The mutagenicity of lipophilic extracts of sediments from the polluted urban Tama River in Japan was examined. The results of the mutagenicity assays showed varying mutagenicity and mutagenic intensity at the different sampling sites, with the highest mutagenicity in Salmonella typhimurium TA1535 and TA1537 observed at the sampling station which was located in the Keihin Industrial Zone, and therefore affected by the industrial wastes. It is concluded that this method is useful for the estimation of total environmental risk. (Wood-PTT)
W88-04133

RATE CONSTANTS FOR SOME OXIDATIONS OF S(IV) BY RADICALS IN AQUEOUS SOLUTIONS,

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
For primary bibliographic entry see Field 2K.
W88-04136

MEASUREMENT OF THE ENTRAPMENT OF SULFUR DIOXIDE BY RIME ICE,

Nevada Univ. System, Reno. Desert Research Inst.
D. Lamb, and R. Blumenstein.
Atmospheric Environment ATENBP, Vol. 21, No. 8, p 1765-1772, August 1987. 2 fig, 2 tab, 14 ref. US Forest Service Contract 40-82FT-5-811.

Descriptors: *Acid precipitation, *Path of pollutants, *Chemistry of precipitation, *Clouds, *Ice, *Sulfur dioxide, *Rime, Fluid drops, Supercooling, Sulfur compounds, Chemical reaction, Freezing, Entrapment, Regression analysis, Mathematical studies, Simulation analysis.

Experiments were conducted to measure the fraction of SO2 dissolved in supercooled cloud drops which remains with the ice phase following rime-ice formation. Special consideration is given to an experimental design which simulates the atmospheric riming process realistically and to measurement uncertainties. The results show the fraction f sub S(IV) of SO2 entrapped by the riming process to be proportional to the drop supercooling deltaT, suggesting that the mechanisms of entrapment may be linked to the growth of ice during the adiabatic portion of drop freezing. A regression analysis shows: f sub S(IV) = a times deltaT + b, where a =0.0058 plus or minus 0.0005/K and b = 0.012 plus or minus 0.006. No evidence was found for sulfate formation subsequent to entrapment in the rime ice. (Author's abstract)
W88-04137

SPATIAL DISTRIBUTION OF CHLORIDE AND SULFATE IN THE SNOW COVER IN SAPPORO, JAPAN,

Tokyo Metropolitan Univ. (Japan). Dept. of Geography.
K. Suzuki.
Atmospheric Environment ATENBP, Vol. 21, No. 8, p 1773-1778, August 1987. 9 fig, 1 tab, 13 ref.

Descriptors: *Acid precipitation, *Chlorides, *Sulfates, *Snow cover, *Path of pollutants, Fate of pollutants, *Water pollution sources, *Spatial distribution, Japan, Deposition, Seawater, Sapporo, Snow.

A chemical study of snow cover in Sapporo was undertaken in February 1981 to assess different deposition patterns of ions of different origins. Twenty samples of the snow cover were collected, and the concentration of major ions was determined. The Cl in the snow cover was determined to come from seawater. The Cl concentrations near the seashore was larger than that inland, and was lowest south of the city center of Sapporo. This distribution of the Cl concentration in the snow cover showed a trend similar to the density of snow cover and was directly related to mean wind speed. The excess SO4 concentration was lowest in the city center, and a high concentration band of excess SO4 was observed southeast of the city center. Conversely, mean concentration of SO2 in the air in winter is highest in the city center. This difference is explained by an urban heat island effect and a snow deposition pattern. The air converges and ascends in the city center. Northwest winds, which bring a large amount of snow to Sapporo, pick up this SO2 and cause a high concentration band of SO4 to be deposited in snow in the area southeast of the city center. (Author's abstract)
W88-04138

AMMONIA EMISSIONS AND THEIR ROLE IN ACID DEPOSITION,

Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
H. M. ApSimon, M. Kruse, and J. N. B. Bell.
Atmospheric Environment ATENBP, Vol. 21, No. 9, p 1939-1946, September 1987. 3 fig, 4 tab, 28 ref.

Descriptors: *Acid rain, *Ammonia, *Acid deposition, *Path of pollutants, *Fate of pollutants, Deposition, Spatial distribution, Temporal distribution, Oxidation, United Kingdom, Farm wastes, Seasonal variation, Ammonia emissions, Pollutants.

The importance of atmospheric ammonia (NH3), generated from livestock wastes and by fertilizer application, is described and the derivation of a detailed emissions inventory of NH3 for the United Kingdom is presented. It was previously shown that the presence of NH3 can increase oxidation rates of SO2 in clouds by more than an order of magnitude, and can induce correspondingly high concentrations of sulfur in precipitation. Since NH3 plays an important role in altering oxidation and pollutant deposition systematically on a regional basis, the spatial and temporal variations in emissions of the gas are detailed and the seasonal trends taken into account. Seasonal trends indicate a higher deposition of sulfate in summer than in winter in spite of lower SO2 emissions. Studies of longer term trends imply a 50% increase in NH3 emissions over Europe as a whole between 1950 and 1980, with the emissions doubling in some countries. The effect of such systematic spatial and temporal variations in NH3 emissions on the pattern of acid depositions over Europe is investigated. (Wood-PTT)
W88-04140

ACCUMULATION OF PESTICIDES IN THE ORGANS OF CARP, CYPRINUS CARPIO L., AT 4 DEGREES AND 20 DEGREES C,

Jozsef Attila Univ., Szeged (Hungary). Dept. of Biochemistry.
J. Nemcsok, L. Orban, B. Asztalos, and E. Vig.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 370-378, September 1987. 6 fig, 2 tab, 12 ref.

Descriptors: *Pesticides, *Fish, *Path of pollutants, *Water pollution effects, Carp, Fish physiology, Water pollution, Fungicides, Paraquat, Herbicides, Water temperature, Seasonal variation, Temperature effects, Toxicity, Carbon radioisotopes, Radioisotopes, Bioaccumulation.

Pesticides can accumulate in the organs of aquatic animals and become more concentrated, especially in animals at the higher end of the food chain. Accumulation of CuSO4, used as a fungicide, and paraquat, used as an herbicide, was studied in the various organs of the carp at winter and summer water temperatures of 4 C and 20 C respectively. With the exception of the brain, greater copper accumulation was measurable in every organ at 20 C than in those measured at 4 C. The in vivo accumulation of C14-labelled paraquat in Cyprinus carpio L. depended on the exposure time and water temperature. Seasonal accumulation data is provided to allow prediction of damaging effects caused by the temperature-dependent pesticide accumulation. Even at low concentrations, paraquat was previously shown to be extremely toxic since the free radicals formed during the pesticide metabolism in the fish cause degradation of the cell membranes. Paraquat and CuSO4 both damage the nervous system through the inhibition of acetylcholinesterase. (Wood-PTT)
W88-04143

PRIMARY BIODEGRADATION KINETICS OF ANIONIC SURFACTANTS IN MARINE ENVIRONMENT,

Cadiz Univ. (Spain). Faculty of Sciences.
D. Sales, J. M. Quiroga, and A. Gomez-Parra.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 385-392, September 1987. 3 fig, 2 tab, 15 ref.

Descriptors: *Surfactants, *Biodegradation kinetics, *Fate of pollutants, *Path of pollutants, *Kinetics, Biodegradation, Mathematical equations, Anionic surfactants, Anions, Water pollution, Mathematical studies.

Primary biodegradation kinetics were examined for five anionic surfactants that are representative of the various types used in the manufacture of detergents and other commercial cleaning agents. The experiments were conducted in the presence of sediments, since it was previously established that they substantially increases the process of surfactant degradation. To determine kinetic equations for the biodegradation process, several polynomial expressions from zero to 6th degree were tested for the degradation rate as a function of the residual quantity of surfactant. Temperature effects were considered. Appropriate mathematical equations are presented. Degradation of alkyl-benzenesulfonate (LAS) at temperatures below 15C, and isobexil-isopentil-sulfosuccinate (HPS) at 25C, occurs with a zero order kinetic. With LAS, this can be attributed to the fact that bacterial activity decreases significantly when temperature descends, so that the rate of surface-activity loss becomes independent of the amount of surfactant in the medium. In the case of HPS, this fact may be connected with the scant biodegradability of the surfactant as a consequence of its highly branched aliphatic chain. The surfactant concentration decreases exponentially from the first day of test for alkyl-sulfate (DS) (first order kinetic). (Wood-PTT)
W88-04145

MODEL CHLORINATION OF PLANT DERIVED PHENOLIC WATER CONTAMINANTS WITH AN ASSESSMENT OF THEIR POTENTIAL TOXICITY TO ESCHERICHIA COLI,
Reading Univ. (England). Dept. of Physiology and Biochemistry.
For primary bibliographic entry see Field 5C.
W88-04146

METALS IN CRAYFISH FROM NEUTRALIZED ACIDIC AND NON-ACIDIC LAKES,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
G. Bagatto, and M. A. Alikhan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 401-405, September 1987. 1 tab, 17 ref.

Descriptors: *Acid rain, *Metals, *Acidic water, *Path of pollutants, *Crayfish, *Lakes, *Joe Lake, *Nelson Lake, Monitoring, Crustaceans, Nonacidic water, Heavy metals, Neutralized water, Ontario, Bioaccumulation, Tissue analysis, Water quality.

The concentrations of six metals in freshwater crayfish from Nelson Lake, Ontario, a neutralized acidic lake, are compared with the concentrations in crayfish from Joe Lake, a nearby non-acidic lake. Various tissue concentrations were examined to determine the specific tissue accumulation sites for the metals investigated: copper, cadmium, nickel, manganese, magnesium, and zinc. The general relationship between the crayfish tissue metal concentrations in animals from the two lakes was Cu>Mg>Mn>Zn>Cd>Ni. Although tissue metal concentrations, in general, were not significantly different between crayfish from the two lakes, exoskeletal concentrations of Cu, Cd, and Zn in the two decapod populations were significantly different. It is, however, not known if these differences were due to bioaccumulation of the metals or surface contaminations of the exoskeleton, although the data support the latter. Nickel concentrations in various tissues among the members of the two crayfish populations were highly variable. In the majority of samples from Nelson Lake, the highest concentrations were detected in the exoskeleton and lowest in the viscera, while in the Joe Lake population the highest concentrations were observed in the viscera and the exoskeleton with the hepatopancreas, abdominal muscles and digestive gut relatively free of nickel. It is also suggested that crayfish are a useful monitor of the deterioration and improvement of water quality of acidic lakes which have been neutralized. (Wood-PTT)
W88-04147

MERCURY CONTENT IN THE WATER AND MARINE ORGANISMS IN ANGKE ESTUARY, JAKARTA BAY,
Indonesian Inst. of Sciences, Djakarta. Lab. of Environmental Study.
H. P. Hutagalung.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 406-411, September 1987. 2 fig, 1 tab, 17 ref.

Descriptors: *Mercury, *Water pollution effects, *Angke Estuary, *Estuaries, *Aquatic life, Path of pollutants, Water analysis, Plankton, Fish, Shellfish, Heavy metals, Indonesia, Bioaccumulation, Aquaculture, Human diseases, Mollusks, Fisheries, Fish farming, Industrial wastes, Chemical analysis, Public health.

The Angke Estuary, which is a fishing area, is contaminated by industrial wastes from Jakarta City and neighboring areas; methyl-mercury is assumed to be among the pollutants. Amounts of mercury found in the estuary's water and in marine organisms from the estuary are reported. It was found that the concentration of mercury in the water ranged between 0.007-0.018 ppm which is higher than the maximum mercury concentration of 0.006 ppm suggested by the Indonesian government for waters used for fisheries. The mercury content of the marine organisms investigated was higher than that of the ambient water. Bioaccumulation accounts for the high mercury concentrations found in a bivalve mollusk which feeds on phytoplankton which was also found to be contaminated. Since humans also accumulate mercury by absorption of mercury from food consumed, it is recommended that consumption of contaminated fish be reduced to help prevent Minamata disease and that the water of the mercury-contaminated estuary not be used for aquaculture. (Wood-PTT)
W88-04148

MEASURING TRI-N-BUTYLTIN IN SALMON BY ATOMIC ABSORPTION: ANALYSIS WITH AND WITHOUT GAS CHROMATOGRAPHY,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 5A.
W88-04149

TRACE-METAL AND ORGANOCHLORINE RESIDUES IN SEDIMENTS OF THE UPPER ROCKAWAY RIVER, NEW JERSEY,
Geological Survey, Trenton, NJ.
J. A. Smith, P. T. Harte, and M. A. Hardy.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 465-473, September 1987. 1 fig, 2 tab, 8 ref.

Descriptors: *Water quality control, *Path of pollutants, *Suspended sediments, *Trace metals, *Polychlorinated biphenyls, *Chlorinated insecticides, River sediments, Insecticides, Rockaway River, New Jersey, Statistical analysis, Heavy metals, Spatial distribution, Correlation analysis, Land use, Monitoring.

Because the Rockaway River, New Jersey, eventually empties into a drinking water reservoir, the sediment and water quality of the reservoir and the upper reaches of the river is important. Therefore, it is determined whether trace metals of anthropogenic origins, polychlorinated biphenyls (PCBs), and/or chlorinated insecticides were deposited in the sediments of the upper Rockaway River, and whether variations in the spatial contamination of the river's sediment correspond to changes in the basin's land use. The reach of the river upstream from Washington Pond drains primarily a forested area, while downstream of Washington Pond, the river drains land used primarily for residential, commercial and industrial purposes. Analysis of samples and statistical studies show that the sediments of the upper Rockaway River downstream of Washington Pond are affected by anthropogenic activities; significant residues of PCBs, chlorinated insecticides and trace metals were detected in sediment samples. By contrast, the sediments at sampling stations upstream from Washington Pond were relatively free of trace metal and organochlorine contaminants. The sediment quality in the river corresponds strongly to land-use for the area. Normalizing trace metal concentrations by conservative metal concentrations and normalizing organic compound concentrations by percent organic carbon were useful in the confirmation of spatial contamination variations in sediments of the river. (Wood-PTT)
W88-04151

PERSISTENCE AND MOVEMENT OF ATRAZINE IN A SALT MARSH SEDIMENT MICROECOSYSTEM,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
A. R. Isensee.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 516-523, September 1987. 2 fig, 1 tab, 8 ref.

Descriptors: *Atrazine, *Path of pollutants, *Fate of pollutants, *Salt marshes, *Marine sediments, Pesticides, Marshes, Tidal marshes, Tidal effects, Pollutants, Flooding, Herbicides, Adsorption, Estuaries.

A commonly used herbicide, atrazine, was evaluated in a laboratory salt marsh ecosystem, with respect to its persistence and transport under simulated tidal flux and continuous flooding conditions. Atrazine persistence was also compared under normal field conditions. Movement in the sediment was followed using C14-labelled atrazine. Investigations of the effect of tidal fluctuations on atrazine mobility in and recovery from sediment showed that about 17% of the total C14 moved vertically from the treated to the untreated sediment in three days; little additional movement occurred with more time. Only 1 to 3% of the total C14 moved laterally to the untreated sediment located downslope from the treated sediment. Adsorption of atrazine to the high organic carbon (11.2%) sediment prevented further movement in either vertical or lateral directions. Further evidence of atrazine binding is indicated by the decreasing extraction efficiency over time. Atrazine extractability from field soil was more complete than from sediment, since the organic carbon content of soil (1.0%) was much lower than the sediment. The results indicate that atrazine is rapidly inactivated by adsorption and/or metabolism in estuarine sediment. This is important in estuary-agriculture interface areas such as the Eastern Shore Areas of the Chesapeake Bay where much of the runoff from agricultural land enters the estuary through salt marshes. The water-sediment interactions caused by tidal fluctuations in salt marshes may serve to inactivate sediment-borne pesticides. (Wood-PTT)
W88-04152

MICROBIAL ENHANCEMENT OF HYDRAZINE DEGRADATION IN SOIL AND WATER,
Florida Univ., Gainesville. Dept. of Soil Science.
L. T. Ou, and J. J. Street.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 541-548, September 1987. 7 tab, 5 ref. US Air Force Grant F08635-83-C-0136.

Descriptors: *Hydrazine, *Microbial degradation, *Fate of pollutants, *Path of pollutants, *Degradation, *Water pollution control, *Soil, Microbiological studies, Achromobacter, Bacteria, Biodegradation, Phosphates, Hydrogen ion concentration.

Previous studies indicated that hydrazine was more rapidly degraded in soils containing Achromobacter so it is postulated that innoculating water and soil samples with the hydrazine-degrading bacterium will enhance hydrazine degradation. The factors that influence hydrazine degradation in water and soil are discussed. Two river water samples, two lake water samples, one tap water sample, one distilled water sample, and Arredondo fine sand were selected. Hydrazine was not degraded in any of the water samples during two hours of incubation. However, hydrazine was not stable in these water samples when suspended with 18 hour-old cells of Achromobacter the degree of stability in the cell suspensions depended on the hydrazine concentration and type of water. When the water samples were buffered with phosphates, the degradation capacity of the Achromobacter in

most samples was enhanced. The critical pH value was approximately 3.5 since below that value the bacteria degradation capacity decreased dramatically. Degradation of hydrazine in soil treated with Achromobacter was not significantly different (1% level) at hydrazine concentrations of 100 to 500 micrograms/gram although addition of the bacterium to soil suspensions (10% soil) did enhance hydrazine degradation. The degree of enhancement by the bacterium in the soil suspensions was not as great as in the water samples. Explanations for this behavior are suggested. (Wood-PTT)
W88-04153

HIGHLY TOXIC COPLANAR PCBS: OCCURRENCE, SOURCE, PERSISTENCY AND TOXIC IMPLICATIONS TO WILDLIFE AND HUMANS,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
S. Tanabe, N. Kannan, A. Subramanian, S. Watanabe, and R. Tatsukawa.
Environmental Pollution (Series A) EPEBD7, Vol. 47, No. 2, p 147-163, 1987. 7 fig, 6 tab, 31 ref. Ministry of Education, Science and Culture of Japan Grant 60030060.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Fate of pollutants, *Water pollution sources, *Toxicity, Organic compounds, Fish, Aquatic animals, Marine animals, Mammals, Fish, Fatty tissues, North Pacific, Metabolism, Tissue analysis, Bioaccumulation, Pollutant identification.

Isomer-specific determinations of PCB congeners in a wide variety of animal species such as fish, marine animals (whale, dolphin and porpoise) and terrestrial mammals (dog, cat and human) revealed the environmental occurrence of highly toxic coplanar 3,3',4,4'-tetrachlorobiphenyl (T4CB), 3,3',4,4',5-pentachlorobiphenyl (P5CB), and 3,3',4,4',5,5'-hexachlorobiphenyl (H6CB) within a range of a few picograms/gram to several ten nanograms/gram in fat tissues (except fish) on a wet weight basis. Detection of these toxic residues in wild specimens collected from remote areas such as the North Pacific suggests the already widespread distribution of coplanar PCBs, as in the case of general PCB pollution. The clear positive correlations between concentrations of total PCBs and each of the three coplanar PCBs obtained in all mammals analyzed suggest that the sources of coplanar PCB contamination to the environment are mainly commercial PCB preparations. Comparisons of the composition of three toxic coplanar PCBs in commercial PCB mixtures and in the various animals indicates that the relative metabolizability of these congeners is as follows: T4CB > P5CB > H6CB. Moreover, marine mammals have less ability to metabolize the coplanar PCBs in comparison with terrestrial mammals. In human adipose tissues, the concentrations of coplanar PCBs were much higher than 2,3,7,8-tetrachlorodibenzo-p-dioxin (T4CDD), 2,3,4,7,8-pentachlorodibenzofuran (P5CDF) and other toxic congeners. 'T4CDD-equivalent' analysis based on the enzyme induction potencies and the residues of these toxic chemicals indicates that P5CB may pose a greater threat than dioxins and furans to humans and probably also to wildlife. (Author's abstract)
W88-04155

NUCLEAR REPOSITORIES IN NEW ENGLAND - A REGIONAL THREAT TO WATER RESOURCES,
New Hampshire Hazardous Waste, Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 5E.
W88-04163

IDENTIFICATION OF OIL SPILLS IN HARBOURS BY MEANS OF PATTERN RECOGNITION,
Katholieke Univ. Nijmegen (Netherlands). Inst. for Theoretical Physics.
M. M. A. Ruyken, and F. W. Pijpers.
Analytica Chimica Acta ACACAM, Vol. 194, p 25-35, March 16, 1987. 5 fig, 5 tab, 18 ref.

Descriptors: *Oil spills, *Water pollution sources, *Path of pollutants, *Pollutant identification, *Gas chromatography, *Harbors, Fate of pollutants, Water pollution, Oil pollution, Oil, Oily water, Weathering, Netherlands, Mathematical equations.

For environmental control purposes, floating oil spills in Europoort (Rotterdam) harbors must often be identified and their sources located. Pattern recognition, applied to gas chromatographic data for the spill and for various suspected sources, such as oil from bunkers of passing ships and from harbor installations, can lead to definite conclusions, particularly after artificial weathering formulae are used. In order to enhance the reliability of this method, the data set should be increased considerably. Recording of gas chromatograms with capillary columns provides more reliable identification of small iso-alkane and naphthene signals that would improve the selectivity of the identification. Extension of the procedure with measurement of infrared absorption spectra would also improve selectivity without requiring a mathematical selection procedure different from that described here. Identification based on quadratic logarithm values offer the advantage that when the two methods lead to conflicting results, the unreliability of the identification is obvious. Mathematical correction of oil samples for weathering, based on selective evaporation of the light-end fractions of the sample seems a powerful means of improving identification. Possible further improvement for the description of weathering must be based on better experimental evidence. (Wood-PTT)
W88-04164

NATURAL CAUSE FOR MERCURY POLLUTION AT CLEAR LAKE, CALIFORNIA, AND PALEOTECTONIC INFERENCES,
Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
J. C. Varekamp, and A. F. Waibel.
Geology GLGYB, Vol. 15, No. 11, p 1018-1021, November 1987. 2 fig, 30 ref.

Descriptors: *Water pollution sources, *Mercury, *Clear Lake, *California, *Geochemistry, Lake sediments, Paleohydrology, Geothermal studies.

Mercury measurements in lake sediments from cores from Clear Lake, California, reveal that high Hg levels (up to 65 ppm) have been characteristic for the sediments for >10,000 yr. A strong Hg anomaly occurs in sediments deposited between 10.5 and 8.5 (thousand yr), which the authors relate to a period of relatively rapid tectonic subsidence of part of Clear Lake. It is hypothesized that mercury-rich geothermal fluids rose along the activated fractures and faults and were discharged into the lake, causing the anomalously high Hg content of the sediments and leading to deposition of the Sulphur Bank Hg deposit. The total amount of Hg discharged into Clear Lake over the past 15 ka is estimated to be at least 2400 metric tons. Chemostratigraphy of lake sediments in geothermally active areas may hold promise for the detection and dating of major paleoseismic periods. (Author's abstract)
W88-04174

TRANSPORT OF REACTIVE SOLUTE IN SPATIALLY VARIABLE SOIL SYSTEMS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
S. E. A. Van der Zee, and W. H. Van Riemsdijk.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2059-2069, November 1987. 7 fig, 46 ref, 2 append.

Descriptors: *Solute transport, *Soil water, *Soil water contamination, *Path of pollutants, Mathematical analysis, Mathematical studies, Fluid velocity, Stochastic analysis, Probability distribution, Flow patterns.

Transport was studied for reactive solutes and one-dimensional fluid flow with sorption described by the Freundlich equation. For a physically and chemically homogeneous soil column and if the constant feed concentration is larger than the initial concentration, the transport occurs in a traveling wave-type displacement, with a constant shape of the solute concentration front and constant front propagation velocity. Field scale transport is described as an ensemble of shock fronts in parallel columns with different flow velocities v, retardation factors r, and times of solute input, t sub c. These stochastic variables are characterized by probability density functions (PDF). If lognormal distributions are assumed, a simple expression for the field-averaged profile of dimensionless sorbed solute (gamma) at a particular time is derived. If t sub c is not a distributed variable, but equal to the total time tau, the profile (gamma) coincides with the field-averaged dimensionless concentration profile. Scaling theory, leading to the PDF of the fluid velocity, may be incorporated in the model. For reasonable parameter values and statistics of the stochastic variables the gamma profiles are calculated. The effect of a stochastic retardation factor, with statistics derived from the distributions of pH and oc (organic carbon content) found for 84 soils, appears to be profound. The field-averaged displacement calculated is nonsigmoid for the PDFs of oc, pH, and t sub c chosen. This phenomenon is amplified if v and r are assumed negatively correlated. Modeling of horizontally large soil systems with averaged properties will in general lead to an underestimation of the moment of first breakthrough at a particular reference level, such as the phreatic water level. (Author's abstract)
W88-04183

INTERACTING PRECIPITATION/DISSOLUTION WAVES: THE MOVEMENT OF INORGANIC CONTAMINANTS IN GROUNDWATER,
Texas Univ. at Austin. Dept. of Chemical Engineering.
M. A. Dria, S. L. Bryant, R. S. Schechter, and L. W. Lake.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2076-2090, November 1987. 9 fig, 6 tab, 45 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Inorganic compounds, Chemical reactions, Chemical precipitation, Dissolution.

Chemical reactions with minerals occur in groundwater flow in permeable media to produce zones of constant solid and aqueous phase compositions. These zones are separated by 'waves' or step changes in composition. The occurrence of wave-wave interactions resulting from nonuniform boundary conditions has important implications in inorganic pollutant transport through permeable formations. Three physical flow situations produce these conditions: injection of a finite volume of fluid followed n time by a compositionally different fluid, the flow of a reactive fluid through a compositionally layered media, and reversal in the direction of flow of a chemically reactive fluid. The theory presented here applied to contaminant transport indicates that a significant amount of contaminant initially precipitated can be redissolved during subsequent flow, and the patterns thus evolved can indicate the nature of the contaminating source. (Author's abstract)
W88-04185

SOLUTE TRANSFER AND EXTRACTION FROM TRICKLE IRRIGATION SOURCE: THE EFFECTIVE HEMISPHERE MODEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 3F.
W88-04186

LABORATORY INVESTIGATION OF LONGITUDINAL DISPERSION IN ANISOTROPIC POROUS MEDIA,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W88-04192

LEACHING OF TOXIC METALS FROM INCINERATOR ASHES,
Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 5A.
W88-04201

MODELING OF MIREX LOADINGS TO THE BOTTOM SEDIMENTS OF LAKE ONTARIO WITHIN THE NIAGARA RIVER PLUME,
Canada Centre for Inland Waters, Burlington (Ontario).
E. Halfon.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 18-23, 1987. 2 tab, 15 ref, append.

Descriptors: *Mathematical models, *Mirex, *Niagara River, *River sediments, *Lake Ontario, *Path of pollutants, *Pollutant identification, Sediment contamination, Pollutant load, Chemical analysis.

A mathematical model was used to reproduce the observed Mirex concentrations in the bottom sediment within the Niagara River plume in Lake Ontario. Mirex inputs to the sediments were estimated with an optimization technique using historical concentration records; two bottom sediment scenarios were explored, one with no resuspension of sediments, and one with sediment resuspension. Results show that over 34 years a minimum of 8.74 mg of Mirex was deposited over a square meter, but that as much as 12.3-18.7 mg of Mirex might have sedimented before being partially resuspended. This analysis permits an estimation of past Mirex loadings to Lake Ontario, assuming that a constant amount of Mirex in the water column sedimented in the plume. The computed loadings are 28 kg for 1980, compared with a previous estimate of 5-25 kg to a maximum of about 200 kg/yr in 1960-1962. Knowledge of the inputs, followed by a good in-lake data base including contaminant concentrations in sediments at different stations, are key factors in the success of models dealing with trace contaminants. (Author's abstract)
W88-04204

DISTRIBUTION AND CHARACTERIZATION OF PCBS IN LAKE MICHIGAN WATER,
Wisconsin Univ.-Madison. Water Chemistry Program.
D. L. Swackhamer, and D. E. Armstrong.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 24-36, 1987. 5 fig, 3 tab, 58 ref. EPA Contract No. CR807836010.

Descriptors: *Polychlorinated biphenyls, *Lake Michigan, *Path of pollutants, *Pollutant identification, Chemical analysis, Fate of pollutants, Partitioning, Suspended solids, Organic carbon.

Polychlorinated biphenyls (PCBs) were measured in the water column of Lake Michigan at 28 stations. Distributions between dissolved and particulate phases were used to evaluate the partitioning behavior of PCBs. The average PCB concentration in Lake Michigan was 1.8 nanograms/L, corresponding to a total PCB burden of 8,900 kg. The average PCB concentration was significantly lower in open lake (1.2 nanograms/L) than in nearshore zone samples (3.2 nanograms/L). Concentrations in Green Bay were elevated compared to the rest of the lake. Variations in concentration with depth were small. The average log of the water-particle partition coefficient (Kp) was 5.9. Little dependence of Kp on particulate organic carbon was observed. A relationship was found between log Kp and log SPM (suspended particulate matter) concentration, perhaps reflecting association of a non-filterable fraction of the SPM with the aqueous phase. Selected PCB congener Kp and Koc (Kp x organic carbon weight-fraction) values were measured and related to congener Kow (octanol-water partition coefficient), yielding the predictive relationship log Koc = 4.2 + 0.34 log Kow. Cogener log Kp values are predicted to range from 4.8 to 6.1, indicating that congener fates in the water column differ and are partly controlled by their physical chemical properties. (Author's abstract)
W88-04205

METALS AND ESSENTIAL ELEMENTS IN HERRING GULLS FROM THE GREAT LAKES, 1983,
Canadian Wildlife Service, Burlington (Ontario). Ontario Region.
J. Struger, J. E. Elliott, and D. V. Weseloh.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 43-55, 1987. 1 fig, 7 tab, 64 ref.

Descriptors: *Metals, *Herring gulls, *Great Lakes, *Tissue analysis, *Path of pollutants, Lead, Cadmium, Mercury, Toxicity, Water fowl, Chemical analysis, Water birds, Bioaccumulation.

Adult and prefledged herring gulls were collected from one location each in Lakes Ontario, Erie, Huron, and Superior. Composite samples of liver, kidney, and feather were analyzed for 24 elements and composite samples of bone for 22 elements. Concentrations of 16 elements (Al, Ca, Cd, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, P, Pb, Sr, Ti, Zn) in liver, kidney, and feather were accepted for presentation while 6 elements were accepted from bone (Ca, Cd, Hg, P, Pb, Zn). Only lead, cadmium, and mercury values were of toxicological interest. Data on other trace elements are presented as baseline values among locations for each tissue and age class. Concentrations of Cd, Pb, and Kg were higher in adults than in prefledged young. Metal levels varied among different tissues with Cd highest in kidney (2.16 micrograms/gm; Hamilton Harbor, Lake Ontario), Pb highest in bone (30.0 micrograms/gm; Double Island, Lake Huron), and Hg highest in feather (6.11 microgorams/gm; Middle Island, Lake Erie). Lead levels in both age classes were generally higher in tissues from the Lakes Superior and Huron colonies than in samples from Lakes Erie and Ontario. Cadmium and mercury levels did not vary greatly among locations. Levels found are below those associated with metal toxicoses in laboratory studies with other avian species. (Author's abstract)
W88-04207

TRACE CONTAMINANT STATUS OF HAMILTON HARBOUR,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5A.
W88-04221

UNSTABLE FLOW IN LAYERED SOILS: A REVIEW,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
D. Hillel.
Hydrological Processes HYPRE3, Vol. 1, No. 2, p 143-147, March 1987. 21 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Soil water, *Unstable flow, *Stratification, *Groundwater movement, *Infiltration, Groundwater recharge, Solute transport, Vadose zone, Model studies, Flow profiles.

Release of water from the soil in the process of internal drainage, and its continued downward movement through the vadose zone, constitute the main mechanism of groundwater recharge. Water released from the soil generally contains solutes, and these are conveyed to the groundwater via the same pathways as the drainage water. Knowledge of those pathways is essential in any attempt to minimize the likelihood of groundwater pollution. Solutes generally interact with the medium in which they reside or travel, and the spatial and temporal pattern of their movement influences the nature and the extent of their interactions. The assumption had prevailed that flow in the vadose zone is a steady-state, uniform process. Recently, however, the existence of preferred pathways has come to light. Such pathways might connect the soil's upper zone directly to the water-table, thus bypassing the greater volume of the vadose zone and evading its filtering mechanisms. Groundwater recharge models that ignore the possibility of such spurts of contamination may be highly misleading. Preferred flow path may be cracks, animal burrows, or decayed root channels. Less easily discernible are transient and random paths associated with the phenomenon of 'unstable flow', which is most likely to occur in layered soils during infiltration. The wetting front, instead of remaining horizontal and advancing continuously from one layer to the next, may begin (particularly in transition from a fine-textured to a coarse-textured layer) to form bulges, called 'fingers', which propagate downwards and may become, in effect, vertical pipes. (Author's abstract)
W88-04240

SOIL WATER DYE TRACING, WITH SPECIAL REFERENCE TO THE USE OF RHODAMINE WT, LISSAMINE FF AND AMINO G ACID,
Sheffield Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-04241

SCALE EFFECTS IN FLUVIAL SEDIMENT-ASSOCIATED CHEMICAL DATA,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 2J.
W88-04242

SEDIMENT DESORPTION OF PCB CONGENERS AND THEIR BIO-UPTAKE BY DIPTERAN LARVAE,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
L. W. Wood, G. Y. Rhee, B. Bush, and E. Barnard.
Water Research WATRAG, Vol. 21, No. 8, p 875-884, August 1987. 8 fig, 3 tab, 38 ref.

Descriptors: Polychlorinated biphenyls, *Bioaccumulation, *Path of pollutants, *Fate of pollutants, *Lake sediments, Sediment contamination, Octanol-water partition, Aroclor, Chemical analysis, Gas chromatography.

Sediment desorption of PCB congeners and their bio-uptake by Chironomus tentans Fabricus were investigated in a continuous flow system. The desorption of 71 congeners (in Aroclors 1221, 1016, 1254, and 1260) determined by glass capillary gas chromatography could be described by a first order function. The release rate of the individual congeners was inversely related to their octanol/water partition coefficients (K sub ow). The depth of mobilization generally decreased with the number of chlorine substitutions and was inversely related to K sub ow. Bio-uptake of the congeners by Chironomus tentans Fabricus was selective with the bio-uptake factor being highest for those with 2-4 chlorines. There was no correlation between the factor and either K sub ow or desorption rate from the sediments. (Author's abstract)
W88-04247

FLUORIDE IN IRRIGATION WATERS OF AGRA DISTRICT, UTTAR PRADESH,
R.B.S. Coll., Bichpuri (India). Dept. of Agricultural Chemistry and Soil Science.
V. Singh, R. Narain, and C. Prakash.
Water Research WATRAG, Vol. 21, No. 8, p 889-890, August 1987. 1 tab, 8 ref.

Descriptors: *Fluoride, *Irrigation water, *Agra, *India, *Water quality, Pollutant identification, Monitoring, Semiarid regions, Barium, Sodium, Salinity.

Underground waters of the semi-arid tract of Agra, India, were examined for their F concentration and other chemical constituents. The F concentration in waters varied from 0.2 to 3.2 mg/L and 56% of the waters contained injurious concentrations of F for drinking water. However, these waters were not harmful for most crops. Fluoride concentration was not correlated with barium or sodium concentration of groundwaters. (Author's abstract)
W88-04249

BIOCONCENTRATION AND METABOLISM OF PHENYLTIN CHLORIDES IN CARP,
Shiga Prefectural Inst. of Public Health and Envi-

ronmental Science, Otsu (Japan).
T. Tsuda, H. Nakanishi, S. Aoki, and J. Takebayashi.
Water Research WATRAG, Vol. 21, No. 8, p 949-953, August 1987. 8 fig, 1 tab, 18 ref.

Descriptors: *Bioaccumulation, *Metabolism, *Phenyltin chlorides, *Carp, *Path of pollutants, *Fate of pollutants, Bioconcentration, Fish, Tissue analysis.

Bioconcentration factors (BCF) in carp (Cyprinus carpio L.) and partition coefficients between n-octanol and water (P sub ow) were measured for triphenyltin chloride (Ph3SnCl), diphenyltin dichloride (Ph2SnCl2) and monophenyltin trichloride (PhSnCl3). Log P sub ow was 2.11 for Ph3SnCl, 1.43 for Ph2SnCl2 and 1.73 for PhSnCl3. The order of log BCF was kidney > liver > muscle > or = to gallbladder for Ph3SnCl, liver > kidney > or = gallbladder > muscle for Ph2SnCl2 and kidney > or = liver > gallbladder > muscle for PhSnCl3. Ph3SnCl metabolism in carp was studied. Ph2Sn(2+) and PhSn(3+), the metabolites of Ph3SnCl were detected in muscle and viscera. The ratio of Ph3SnCl, Ph2Sn(2+) (Ph2SnCl2) and PhSn(3+) (PhSnCl3) concentrations by metabolism in each part of carp corresponded to that of BCF by carp for the same phenyltin chlorides. This agreement of both ratios suggests that the concentrations of metabolized Ph2Sn(2+) and PhSn(3+) in muscle were ruled mainly by their BCF. This could be similarly applied to viscera such as liver and gallbladder. (Lantz-PTT)
W88-04257

SINK OR DRAIN: A SIMULATION STUDY OF FACTORS AFFECTING THE ROLE OF AN ESTUARY SUBJECT TO TOXIC INPUTS,
Institute for Marine Environmental Research, Plymouth (England).
J. R. W. Harris.
Water Research WATRAG, Vol. 21, No. 8, p 975-981, August 1987. 7 fig, 3 tab, 6 ref. U.K. Dept. of the Environment Contract No. PECD 7/7/077.

Descriptors: *Estuaries, *Simulation analysis, *Heavy metals, *Path of pollutants, *Tamar Estuary, *Fate of pollutants, England, Mathematical models, Metals, Sediments.

In response to a shift in its mean influx, the concentrations of a refractory substance in an estuary will tend from some initial steady state (subject to environmentally induced variation) to a new level. In the 32 km Tamar Estuary, a partly-mixed estuary in southwest England, the timescale of this transition appears to be < 10-20 years. A published numerical model of pollutant dispersal in the estuary was used to investigate the dependence of this evolution on the mean levels and variation in space and time of the physical and chemical determinants of the system. Except to the extent that the numerical model of the Tamar estuary is based upon observed hydrodynamics and sediment movement, the study was wholly hypothetical. In view of the marked simplification of the complexity of estuarine hydrodynamics in the model of the Tamar estuary employed, considerable ignorance of sediment exchange and mixing, and crude representations of what may be quite involved chemistry, it would be naive to expect more than rather broad qualitative indications of what might occur. The observation of natural switches in input levels such as those simulated here would provide both an indication of the relation these bore to reality and also of the level of sediment exchange and mixing that occurs. It appears that such a change in input has already occurred in the Tamar as a result of metal mining in the middle of the last century. Although this activity was short-lived, the leaching of spoil tips and mine workings has permanently enhanced metal concentrations in the estuary. (Lantz-PTT)
W88-04261

INITIAL DILUTION OF HORIZONTAL JET IN CROSSFLOW,
Hong Kong Univ. Dept. of Civil Engineering.
J. H. W. Lee, and P. Neville-Jones.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 615-629, May 1987. 5 fig, 2 tab, 22 ref.

Descriptors: *Mixing, *Outfall, *Wastewater disposal, *Dispersion, *Dilution, Crossflows, Horizontal flow, Databases, Mathematical models, Flow profiles, Mathematical studies, Design flow.

Available data on the initial dilution of a horizontal round buoyant jet in a perpendicular crossflow were successfully interpreted using length scales and mathematical models. The database consists of in situ measurements of surface dilution in the sewage boil at a number of sea outfalls in the United Kingdom, as well as limited laboratory experimental data. Simple equations for the prediction of minimum initial dilution in an ambient current are supported by the collective data. The dilution constants obtained are comparable to, but greater than, those derived from previous laboratory experiments of a vertical negatively buoyant jet in a crossflow. A correlation for the downstream location of minimum dilution is also provided. The results reported can be readily used in outfall design. (Author's abstract)
W88-04269

HYDRAULICS OF SHALLOW AND STRATIFIED MIXING CHANNEL,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5E.
W88-04270

EFFECTS OF IRRIGATION ON WATER QUALITY OF A SHALLOW UNCONFINED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 6G.
W88-04279

EXAMPLES OF LANDFILL-GENERATED PLUMES IN LOW-RELIEF AREAS, SOUTHEAST FLORIDA,
Geological Survey, Stuart, FL.
G. M. Russell, M. Stewart, and A. L. Higer.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 863-866, October 1987. 4 fig, 2 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Landfills, *Plumes, *Florida, Water table gradient, Fate of pollutants, Prediction, Water table, Leachates, Drainage effects, Mineral water, Permeability coefficient, Groundwater movement, Groundwater pollution, Leaching.

Areas of low topographic relief have low water-table gradients and make the direction of movement of contaminants from landfills in the groundwater difficult to predict from regional gradients alone. The landfill, nearby free-flowing ditches or canals, variations in hydraulic conductivity, and the influence of nearby pumping wells can all affect the direction of flow. In low-gradient areas the concepts of 'upgradient' and 'downgradient' are less useful in planning the location of monitoring wells than in areas of higher relief. Low-relief areas also may be affected by the discharge of mineralized water from deeper aquifers, naturally or through irrigation, which can mask geochemical surveys intended to detect landfill leachate. Examples of effects of low topographic relief are noted in southeast Florida where water-table gradients are 0.0007 to 0.0005 feet per foot. Water table mounding beneath the landfill and the drainage effects of nearby ditches and well have created multiple leachate plumes in Stuart where one plume migrated along two narrow zones. In Fort Pierce it was difficult to detect leachate because of mineralized irrigation water and fertilizer runoff from an adjacent citrus grove. (Author's abstract)
W88-04288

FECAL COLIFORM CONCENTRATIONS IN RUNOFF FROM A GRAZED, RECLAIMED SURFACE MINE,
Agricultural Research Service, Beckley, WV. Appalachian Soil and Water Conservation Research Lab.
D. G. Boyer, and H. D. Perry.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 911-917, October 1987. 1 fig, 3 tab, 21 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Coliforms, *Grazing effects, *West Virginia, Grazing, Surface runoff, Reclaimed mines, Runoff, Bacteria, Appalachia, Coal mines, Watersheds, Fate of pollutants, Streams, Water pollution control, Land use, Bacterial analysis.

The relative scarcity of flat or moderately sloping land in Central Appalachia make reclaimed surface mined lands attractive for agricultural uses. A reclaimed surface coal mine in southern West Virginia was placed under grazing management during the 1984 and 1985 growing seasons. Discharge was collected from summer-grazed watersheds of about 2.8 hectares and 8.9 hectares and analyzed, by the membrane filtration method, for fecal coliforms (FC). Prior to grazing, in 1984, FC counts were < 20/100 milliliters (ml). During the grazing season, FC ranged from < 0/100 ml to > 1000/100 ml in 1984 and from 0/100 ml to > 2500/100 ml in 1985. FC counts remained high during warm periods for several months after grazing ceased. It is concluded that the bacteriological quality of receiving streams was affected by grazing the reclaimed area and recommended standards for point sources were often exceeded. However, the FC counts were not greater than what would have been expected from grazed, undisturbed areas. Reclaimed surface mine areas in Appalachia are a potentially valuable 'flat land' resource and grazing appears to be an alternative post-mine land use that affects bacteriological water quality in a similar manner as 'natural' pastures. However, good management practices may be necessary to avoid bacterial contamination of adjacent bodies of water. (Author's abstract)
W88-04295

WATER POLLUTION FORM OIL AND GAS RECOVERY IN EASTERN KENTUCKY WATERSHEDS,
Kentucky Div. of Air Quality, Frankfort. Program Development Branch.
For primary bibliographic entry see Field 5C.
W88-04299

VARIABLE DENSITY FLOW AND SOLUTE TRANSPORT SIMULATION OF REGIONAL AQUIFERS CONTAINING A NARROW FRESHWATER-SALTWATER TRANSITION ZONE,
Geological Survey, Reston, VA.
C. I. Voss, and W. R. Souza.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1851-1866, October 1987. 18 fig, 27 ref, 2 append.

Descriptors: *Solute transport, *Density flows, *Path of pollutants, *Saline-freshwater interfaces, *Aquifers, Model studies, Interfaces, Fate of pollutants, Simulation analysis, Hawaii, Mathematical models, Mathematical equations, Mathematical studies, Aquifer systems.

Variable density flow and solute transport simulation of aquifer systems containing narrow transition zones between freshwater and saltwater requires particular attention to certain aspects of the numerical method and its application to be successful. Typically, only cases involving wide transition zones have been simulated with variable density transport models, possibly because of inaccuracies in the modeling approaches used. The major components of a successful approach are threefold. First, a functionally consistent approximation of terms involved in fluid velocity calculations is necessary. In the case of Galerkin finite element methodology, a significant modification is required to the standard approach in order to achieve consistency. Second, the simulator must be verified in a particular series of tests. The usual tests using Henry's problem for the verification of density-dependent transport simulators are inadequate to check for consistency of the velocity approximations and for the accuracy of simulating flow

driven by bouyancy forces. Third, adequately fine discretization is required when applying the simulator for spatial stability of the numerical transport solution and to allow accurate representation of narrow transition zones and the effects of low transverse dispersivity. The effectiveness of this approach is demonstrated through the simulation of the flow of fresh and saline groundwater in the layered basalt aquifer of southern Oahu, Hawaii. The transition zone in this regional flow system is narrow except near the discharge area where it is broadly dispersed. Simulation of this common situation with an inconsistent approximation gives grossly incorrect results, while simulation with a consistent model provides a robust tool for analysis of system hydrology. (Author's abstract)
W88-04306

DAGAN MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: FOUNDATIONAL ASPECTS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2F.
W88-04307

PARAMETER ESTIMATION THROUGH GROUNDWATER TRACER TESTS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
K. A. Rainwater, W. R. Wise, and R. J. Charbeneau.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1901-1910, October 1987. 6 fig, 2 tab, 29 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Tracers, *Model studies, *Groundwater movement, Pollutants, Solute transport, Multiple wells, Hydraulic properties, Mathematical equations, Wells, Mathematical models.

The in situ estimation of parameters in chemical models describing groundwater pollutant transport and fate is considered. During tracer tests, the observed breakthrough of a conservative species yields information characterizing the hydraulic behavior of a multiple-well system. A streamline advective solute transport model incorporating the chemical model of interest is scaled so that it applies to all streamlines in the flow system. The hydraulic and chemical data are coupled through a combination integral which calculates the production well effluent concentration of a reactive tracer as a function of time. This mathematical model is then combined with the measured effluent data and a nonlinear estimation procedure to estimate the parameters in the chemical models. The procedure is tested in controlled laboratory experiments. Six experiments, including two- and three-component exchange, were observed. The parameter estimation procedure calculated sensitivity coefficient and cation exchange capacity values derived through batch equilibrium tests, implying nonequilibrium behavior or nonuniform distributions of exchange sites within the porous medium. Both situations are very likely in actual field situations, so estimation of effective parameters is still very useful. Field applications are to be presented in the future. (Wood-PTT)
W88-04311

SIMULATION OF SOLUTE TRANSPORT USING A CONTINUOUS TIME MARKOV PROCESS: 1. THEORY AND STEADY STATE APPLICATION,
North Dakota State Univ., Fargo. Dept. of Soil Science.
R. E. Knighton, and R. J. Wagenet.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1911-1916, October 1987. 4 fig, 17 ref.

Descriptors: *Solute transport, *Fate of pollutants, *Path of pollutants, *Soil water, *Markov process, Chemical degradation, Biodegradation, Crop effects, Solutes, Pollutants, Probability distribution, Soil columns, Nitrates, Bromides, Soil profiles, Leaching, Mathematical equations, Model studies, Soil Contamination, Adsorption, Mathematical analysis.

A continuous time Markov process is developed and used to describe chemical movement through the soil under steady state water flow regimes. Theoretical considerations are made to include chemical and biological degradation, crop uptake, and adsorption as processes which affect the probability of movement of a molecule of solute between adjacent soil layers. Probability distributions of solute are given for each soil layer given the flux of soil water and the intensity of transition for the source and sink terms. Predicted solute concentrations of nitrate and bromide compared favorably with observed concentrations collected from a laboratory soil column study under steady state water flow. The model, however, shows a dependency on the number of layers used to simulate the soil profile. The approach offers substantial promise for description of spatially variable solute movement in field soils. This is examined in a companion paper. (See also W88-04313) (Author's abstract)
W88-04312

SIMULATION OF SOLUTE TRANSPORT USING A CONTINUOUS TIME MARKOV PROCESS: 2. APPLICATION TO TRANSIENT FIELD CONDITIONS,
North Dakota State Univ., Fargo. Dept. of Soil Science.
R. E. Knighton, and R. J. Wagenet.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1917-1925, October 1987. 11 fig, 2 tab, 8 ref.

Descriptors: *Solute transport, *Path of pollutants, *Field test, *Soil contamination, *Soil water, *Markov process, Model studies, Fate of pollutants, Crop effects, Solutes, Pollutants, Nitrates, Bromides, Leaching, Aeration zone, Simulation analysis, Mathematical analysis.

A technique for modeling the movement of solutes in the unsaturated zone using a continuous time Markov process is presented and field-tested under a transient water flow regime. Three treatments, one fallow and two cropped, were used to quantify the effect of crop uptake on water and solute movement and to test model performance under field conditions. Field measured NO3(-) and Br(-) concentrations were simulated quite well using three scenarios of water flux. Average water fluxes calculated from 40 observations within a treatment and used to estimated water flow resulted in the best simulations, while the average water flux plus one standard deviation (SD) represented a net downward movement of solute, and simulations using average flux minus one SD represented a net upward movement of solute. Under fallow conditions, solute which was unaccounted for by mass balance of measured data was simulated as leached under extreme flux conditions. Simulations of the cropped treatments were improved substantially in inclusion of either a time crop uptake function or a constant crop uptake coefficient. Model predictions were much more sensitive to crop uptake than to the flux of soil water. (See also W88-04312) (Author's abstract)
W88-04313

SELECTIVE TRANSPORT OF HYDROCARBONS IN THE UNSATURATED ZONE DUE TO AQUEOUS AND VAPOR PHASE PARTITIONING,
Geological Survey, Reston, VA. Water Resources Div.
A. L. Baehr.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1926-1938, October 1987. 13 fig, 3 tab, 40 ref, append.

Descriptors: *Path of pollutants, *Fate of pollutants, *Hydrocarbons, *Aeration zone, *Mathematical models, Soil water, Selective transport, Aqueous partitioning, Vapor phase partitioning, Groundwater pollution, Solutes, Organic compounds, Volatility, Gasoline, Mathematical analysis, Model studies, Aromatic compounds.

Long-term groundwater contamination can result from vapors and solutes emanating from organic liquids spilled in the unsaturated zone. The mathematical modeling analysis presented demonstrates for gasoline-range hydrocarbons, and other volatile organics commonly spilled, that diffusive transport in the unsaturated zone is a significant transport mechanism which can cause aqueous and vapor plumes to spread away from the immiscible liquid source, resulting in an increasing groundwater contamination potential. An analytical solution to a one-dimensional version of the transport model allows for the definition of a retardation coefficient which is dependent on phase-partitioning coefficients and moisture content. Significant differences in migration rates should be anticipated between hydrocarbons. A numerical solution was developed for a radially symmetric version of the model defining transport for a multiconstituent contaminant like gasoline. Differences in anticipated migration rates between aromatic and nonaromatic hydrocarbons were clearly demonstrated. A simulation based on the composition of an actual gasoline revealed that aromatic constituents, although constituting a fraction of the initial gasoline composition, completely defined the groundwater contamination potential. This potential changes in time as constituents are selectively removed from the unsaturated zone. Further, the groundwater contaminating potential is quite sensitive to the ground surface boundary characterization. (Author's abstract)
W88-04314

MONTE CARLO STUDIES OF SAMPLING STRATEGIES FOR ESTIMATING TRIBUTARY LOADS,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
R. P. Richards, and J. Haolloway.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1939-1948, October 1987. 8 fig, 7 tab, 14 ref. USEPA Grant R005727-01-3.

Descriptors: *Monitoring, *Water pollution sources, *Pollution load, *Great Lakes, *Path of pollutants, *Fate of pollutants, *Tributaries, *Mathematical studies, Mathematical analysis, Lakes, Monte Carlo method, Estimating.

An important component in the program to identify and reduce sources of pollution to the Great Lakes is the monitoring effort designed to measure the tributary loads of various pollutants. Because monitoring programs were implemented by many different agencies in the USA and Canada, a wide range of sampling frequencies, sampling designs, and load calculation methods are employed. Monte Carlo techniques were used to evaluate the accuracy and precision of the various tributary load estimates, since these are affected by sampling frequency and pattern, calculation method, watershed size, and parameter behavior during storm runoff events. Simulated years consisting of 1460 observations were chosen at random with replacement from data sets of more than 4000 samples. Patterned subsampling of these simulated years produced data appropriate to each sampling frequency and pattern, from which load estimates were calculated; results for all sampling strategies were based on the same series of simulated years. Unstratified and flow-stratified sampling were examined, and loads were calculated with and without the use of the Beale Ratio Estimator. All loads were evaluated by comparison with loads calculated from all 1460 samples in the simulated year. Studies consisting of 1000 iterations were repeated twice for each of five parameters in each of three watersheds. The results show that bias and precision of loading estimates are affected not only by frequency and pattern of sampling and the calculation approach used, but also by the watershed size and the behavior of the chemical species being monitored. Considerable interaction exists between these factors. In every case, loads based on flow-stratified sampling and calculated using the Beale Ratio Estimator provided the best results among the strategies examined. Differences in bias and precision among watersheds and among transported materials are related to the variability of instantaneous fluxes in the systems being monitored. These differences are qualitatively predictable from knowledge of the time behavior of the material and hydrological systems involved. Attempts to derive quantitative relationships to predict the sampling effort re-

quired to achieve a specified level of precision were not successful. (Wood-PTT)
W88-04315

SIMULATION MODEL FOR OIL SLICK TRANSPORT IN LAKES,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, P. D. Yapa, and M. E. Petroski.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1949-1957, October 1987. 5 fig, 2 tab, 38 ref. US Army Corps of Engineers Contract DACA33-85-C-0001.

Descriptors: *Path of pollutants, *Fate of pollutants, *Oil slicks, Lakes, *Computer models, Mathematical equations, Model studies, Algorithms, Pollutants, Oil, Advection, Evaporation, Dissolution, Simulation, Distribution patterns, Lake St.Clair, Water currents, Wind.

A computer model for simulating oil slick movement in lakes by a Lagrangian discrete parcel algorithm is presented. In this model the transformation of an oil slick due to advection, spreading, evaporation, and dissolution is considered. For open water conditions, the movement of the oil slick by water current and wind is considered using the drifting factor formulation. For ice-covered conditions, the drift velocity is determined according to the ice roughness and current velocity. The current distribution in the lake is determined by a rigid lid circulation model. In the spreading process the mechanical spreading of the oil slick due to the balance of inertia, gravity, viscous, and surface tension forces is considered, in addition to the dispersion of the surface oil layer. Boundary conditions along the shore are formulated according to the storage capacity of the shoreline. The model can be used for simulating either instantaneous or continuous oil spills. Sample simulations for oil spills in Lake St. Clair are presented. (Author's abstract)
W88-04316

STUDY OF THERMALLY INDUCED CONVECTION NEAR A HIGH-LEVEL NUCLEAR WASTE REPOSITORY IN PARTIALLY SATURATED FRACTURED TUFF,
California Univ., Berkeley. Earth Sciences Div.
Y. W. Tsang, and K. Pruess.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1958-1966, October 1987. 11 fig, 2 tab, 39 ref, append. USDOE Contract DE-AC03-76SF00098.

Descriptors: *Convection, *Path of pollutants, *Radioactive wastes, *Thermal water, *Groundwater pollution, Groundwater movement, Fate of pollutants, Radioactive waste disposal, Fluid mechanics, Mathematical equations, Simulation analysis, Fluid flow, Buoyancy forces, Tuff, Nevada, Partially saturated rocks, Geohydrology, Water pollution sources.

Because the most likely path by which radionuclides could reach the biosphere from underground repositories is via transport through groundwater, the large-scale fluid movement that would be caused by heat generated by the waste is studied. In a fully saturated medium where liquid is the sole phase present under ambient conditions, the lower density of the heated liquid in the vicinity of the repository results in a buoyancy force that drives the warm liquid upward toward the surface. In a medium which is partially saturated, a similar thermally-induced buoyancy flow is expected for the gas phase. The highly fractured tuff formations at the Nevada Test Site currently being evaluated as a potential repository are located approximately 200 m above the water table in partially saturated rock. Both order of magnitude estimates and numerical simulations are determined for the large-scale movement of both gas and liquid phases in a partially saturated medium in response to the thermal load of a high-level nuclear waste repository. The velocity estimates of buoyancy-driven convection indicate that the gas-phase convection could take place with appreciable velocity, of the order of 20 m/year, while liquid convection is expected to be very slow, on the order of 0.1 millimeters/year. Detailed numerical simulations using an 'effective continuum' approximation to represent fracture effects, confirm the estimates and demonstrate a sensitivity of gas convection to the strength of binary diffusion. (Wood-PTT)
W88-04317

PATTERN OF DISTRIBUTION OF RADIUM 226 IN DRINKING WATER OF TEXAS,
Texas Univ. Health Science Center at Houston. School of Public Health.
I. M. Cech, H. M. Prichard, A. Mayerson, and M. Lemma.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1987-1995, October 1987. 7 fig, 43 ref.

Descriptors: *Radium radioisotopes, *Path of pollutants, *Fate of pollutants, *Drinking water, *Texas, Potable water, Distribution patterns, Distribution, Wells, Maps, Mapping, Water quality management, Water quality.

Concentrations of radium (Ra) as high as 65 pCi/L were previously reported in some of the public water wells in Texas. Yet, the overall pattern of the geologic distribution of Ra or its decay products has not been determined or mapped. Therefore, the distribution of Ra226 in domestic water, (public and individual) in selected regions of the state of Texas was investigated to identify areas where water may contain naturally occurring elevated concentrations of Ra, and to provide much needed information for well development and water quality management. Two regions with anomalously high Ra concentrations were identified, one in the gulf coast, with some concentrations over 20 pCi/L downdip from uranium deposits, and the other in west-central Texas with some concentrations up to 65 pCi/L on the periphery of an igneous uplift. Otherwise, the concentrations of Ra were low, particularly in the west and northwest of the state. (Author's abstract)
W88-04320

DAILY INTAKE OF U-234, -235, -238, TH-228, -230, -232, AND RA-226, -228 BY NEW YORK CITY RESIDENTS,
Department of Energy, New York. Environmental Measurements Lab.
I. M. Fisenne, P. M. Perry, K. M. Decker, and H. W. Keller.
Health Physics HLTPAO, Vol. 53, No. 4, p 357-363, October 1987. 4 tab, 36 ref.

Descriptors: *Radioisotopes, *Uranium radioisotopes, *Thorium, *Radium radioisotopes, *Urban areas, Drinking water, Shellfish, Potatoes, Environmental quality, Population exposure, Foods, New York City, Path of pollutants.

The daily intake of long-lived alpha-emitting members of the U, Th, and Ac series by New York City residents has been estimated from measurements of diet, water and air samples. The total daily intakes from inhalation, food and water consumption in mBq are 18 (U-234), 0.7 (U-235), 16 (U-238), 6 (Th-230), 4 (Th-232), and 52 (Ra-226). From this, it can be inferred that the total daily intakes of Th-228 and Ra-228 are 4 and 35 mBq, respectively. (Author's abstract)
W88-04326

BIOACCUMULATION FACTOR FOR P-32 MEASURED IN BLUEGILL, LEPOMIS MACROCHIRUS, AND CATFISH, ICTALURUS PUNCTATUS,
Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
B. Kahn, K. S. Turgeon, D. K. Martini, S. J. Dunkerly, and R. M. K. El-Shinawy.
Health Physics HLTPAO, Vol. 53, No. 4, p 389-396, October 1987. 2 fig, 3 tab, 19 ref.

Descriptors: *Bioaccumulation, *Phosphorus radioisotopes, *Catfish, *Bluegills, Phosphorus, Radioisotopes, Foods, Fish, Muscle, Estimating, Food chains, Tissue analysis.

The ratio of the bioaccumulation factors for P-32 and phosphorus was determined for edible tissue in two species of freshwater fish by measuring the specific activity (P-32 activity per mg phosphorus) in muscle relative to feed. The P-32 tracer was added to the feed at a uniform level throughout the study. Feeding was at two levels: ad libitum and at a lower but constant intake per body weight. In the main experiment, bluegill were maintained in a large flow-through tank and sacrificed at approximately weekly intervals for 51 d of P-32 accumulation and 28 d of depuration to compare specific activity with values predicted with a mathematical model. In experiments in smaller aquaria, the specific activity in bluegill and catfish muscle was compared at two feeding levels and two temperatures. In addition, unfed fish were exposed to P-32 in water at a known specific activity to determine the extent of phosphorus uptake directly from water. The pattern of specific activity increase and decrease in fish muscle during the accumulation/depuration experiment was consistent with a one-compartment model, so that specific activity ratios at steady state could be predicted from measurements during relatively brief exposures. On this basis, the ratio of the bioaccumulation factors of P-32 and phosphorus in fish feeding ad libitum was 0.081 for bluegill and 0.17 for catfish. At a mean phosphorus bioaccumulation factor of 70,000 the factors for P-32 are 6,000 and 12,000 respectively. The ratios were less at lower phosphorus intakes associated with lower feeding rates; moreover, the lesser value for bluegill occurred at a much lower phosphorus intake than by catfish. The bioaccumulation factor ratio was lower by an order of magnitude at water temperature of 11 C than at 16-27 degrees C, and was lower by two orders of magnitude when phosphorus uptake was from water by unfed fish. (Author's abstract)
W88-04327

SOIL WATER EFFECTS ON CONCENTRATION PROFILES AND VARIATIONS OF RN-222 IN A VADOSE ZONE,
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
For primary bibliographic entry see Field 2F.
W88-04330

BIODEGRADATION OF SUBSTANCES AT LOW CONCENTRATIONS (BIOLOGISCHER ABBAU VON STOFFEN BEI GERINGEN KONZENTRATIONEN),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
U. Pagga.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 101-107, August 1987. 1 tab, 72 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Surface water, *Biodegradation, *Organic compounds, Wastewater treatment, Effluents, Chlorinated hydrocarbons, Aromatic compounds, Literature review, Environmental quality, Rhine River, Path of pollutants.

The testing of a substance's biodegradability is crucial to an assessment of its ecological compatability. A short-lived ecotoxin represents less of a risk than a long-lived one. Modern analytical techniques often show that surface waters and effluent from water treatment plants contain not only long-lived substances but also those that were classified as being biodegradable. In addition to hydraulic reasons for this, there may be microbiological causes, which are discussed through a literature review. Examples of substances that are found in surface waters are also provided. The author concludes with a discussion on the attendant ecotoxicological risks of a substance present at low concentrations in surface water. (Author's abstract)
W88-04338

REMOBILIZATION OF HEAVY METALS FROM RIVER DEPOSITS BY ORGANIC COMPLEXING AGENTS. 2. NOTE: REMOBILIZATION OF CU, PB, CD, NI, ZN, AND MN BY OVERACIDIFICATION OF WATERS AND BY NTA (ZUR REMOBILISIERUNG VON SCHWERMETALLEN AUS FLUSSEDIMEN-

TEN DURCH ORGANISCHE KOMPLEXBILDNER. 2. MITT.: REMOBILISIERUNG VON CU, PB, CD, NI, ZN, AND MN DURCH VERSAUERUNG DES GEWAESSERS UND DURCH NTA),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
F. Dehnad, K. Wisser, and M. Rieck.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 114-117, August 1987. 5 tab, 1 fig, 8 ref.

Descriptors: *Path of pollutants, *Acidic water, *Heavy metals, *Chelation, *Nitrilotriacetic acid, *Rivers, *Hydrogen ion concentration, Chelating agents, Fluvial sediments, Model studies, Elbe River, Acidic waters, Copper, Lead, Cadmium, Nickel, Zinc, Manganese, Fate of pollutants.

Remobilization of Elbe River deposits by NTA content of the river water and as a function of acidity has been investigated. General statements which can be made are: 1) Local overacidification (e.g., due to introduction of acid wastes into surface waters) remobilizes deposited heavy metals which maintains increased concentrations after mixing and neutralization; and 2) Any content of NTA in surface waters remobilizes deposited metals according to their concentrations in solution and to their constants of chelatization. Series of tests indicated that a content of 200 micrograms/l NTA effected at least 95% chelatization by metals, of which 83% was by remobilization of Zn, Ni and Cu alone, and 12% by Ca. (Author's abstract)
W88-04340

ADSORBABLE ORGANIC HALOGEN (AOX) CONTENTS IN FLOWING WATERS OF THE FEDERAL REPUBLIC OF GERMANY (AOX-GEHALTE IN FLIESSGEWAESSERN DER BUNDESREPUBLIK DEUTSCHLAND),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
M. Keller.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 38-42, July 1987. 11 fig, 16 ref.

Descriptors: *Organic compounds, *Pollutant identification, *Path of pollutants, *Halogens, *Water pollution sources, *Pollution load, Chlorinated hydrocarbons, Industrial wastes, Rivers, River systems, Nonpoint pollution sources.

In 1986 the group parameter adsorbable organic halogens (AOX) was determined in several flowing waters. The research program focussed on taking random samples from the Rhine River at Koblenz on workdays, and on investigating the concentration profiles of major rivers in the Federal Republic of Germany. The results obtained from a differentiated examination of the concentration/discharge relation at the Koblenz gauging station allowed a calculation of AOX loads. It has been possible to make a first estimate of load fractions from industrial waste discharges and from non-point pollution sources. Further investigations envisaged for the next years should indicate whether the industrial fraction of the AOX load, which amounts to about 7-10 tons/day in the Rhine at present, will be reduced by using special purification techniques and production changeover measures. Longitudinal profile measurements show the highest AOX concentrations, exceeding 100 micrograms/l on the lower Main and on the Elbe rivers. By contrast, AOX concentrations in the Moselle and Neckar rivers had a much lower level throughout, about 15-30 micrograms/l. In the Rhine, an almost continuous increase in concentrations can be observed from the upper course to the German-Netherlandish frontier, with peak values measured on the upper Rhine in the plumes of pollutants from large-scale industrial waste discharges. (Airone-PTT)
W88-04345

CHLORINATED BENZENES IN THE MIDDLE RHINE - TO THE PROBLEM OF SETTING UP A BALANCE (CHLORIERTE BENZOLE IM MITTELRHEIN - ZUM PROBLEM EINER BILANZIERUNG),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W88-04346

GROUND-WATER CONTAMINATION CAUSED BY READILY VOLATILE CHLORINATED HYDROCARBONS IN THE NEU-ISENBURG AREA (HESSE). EXPLORATION AND SANITARY MEASURES BETWEEN 1983 AND 1986 (GRUNDWASSERVERUNREINIGUNG DURCH LEICHTFLUECHTIGE CHLORIERTE KOHLENWASSERSTOFFE IM BEREICH NEU-ISENBURG (HESSE). ERKUNDUNGS- UND SANIERUNGSMASSNAHMEN 1983/86),
Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany, F.R.).
B. Toussaint.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 48-59, July 1987. 13 fig, 11 ref.

Descriptors: *Ground water, *Chlorinated hydrocarbons, *Geohydrology, Drinking water, Sanitation, Simulation analysis, Water quality, Wells, Industrial wastes, Main River.

When in December 1982 water samples from the wells and drinking water supply net of the Neu-Isenburg Waterworks were analyzed to detect readily volatile chlorinated hydrocarbons, the results were positive. The organic contaminants migrating in a Plio-Pleistocene porous aquifer of the Lower Main basin originate from a large industrial area, since June 1983, explorations have been conducted to discover the emission sources. Hydraulic sanitary measures started in December 1984, using former discharge wells. Optimum locations of new injection wells and infiltration plants could be found on the basis of a mathematical ground-water simulation model. Whereas the protection measures for drinking-water wells could be terminated by December 1986, concerning detection and elimination of numerous local contamination sources within the industrial region, there is yet no end in sight. (Author's abstract)
W88-04347

MAPPING AND RISK ASSESSMENT OF OXYGEN CONSUMPTION BY SEDIMENTS IN THE LOWER ELBE (KARTIERUNG UND RISIKOBETRACHTUNG DER SAUERSTOFFZEHRUNG VON SEDIMENTEN DER UNTER-ELBE),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
I. Noethlich, and W. Reuter.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 81-88, July 1987. 3 fig, 2 tab, 6 ref.

Descriptors: *Water pollution sources, *Oxygen requirements, *Oxidation, *Sediments, *Mapping, *Risks, *Dredging, Rivers, Bacteria, Biological oxygen demand, Temperature effects, Fluvial sediments, Elbe River.

Oxygen consumption by deposited sediments is a characteristic of biochemical processes. The extent of oxygen consumption is dependent on bacterial density, the portion of readily degradable organics, grain-size composition, and rate of sediment redeposition under the effect of turbulent flow. Rise in water temperature accelerates oxygen consumption (approx. 9.5 - 9.8 % Celsius degree in the range from 10 degrees C to 20 C). Oxygen consumption by suspended sediments is characterized first by chemical oxidation of reduced, predominantly inorganic constituents. Of decisive importance is the usually present anaerobic portion of deeper sediment layers which are removed during dredging and thus enter the suspended state. The consumption of O2 will increase in rate depending on the thickness of this layer. If sediment suspensions are aerated with oxygen, the consumption intensity of suspensions will generally be reduced within a 20-minute aeration time. Sandy suspensions are readily oxidizable; by contrast, mud sediments maintain their consumption intensity for a longer time. Depending on the anaerobic conditions within in the sediments, the difference in O2 consumption between aerated and non-aerated suspensions is variably high. The hazard represented by dredged sediments (endangerment of the oxygen balance) will grow with an increasing rate of O2 consumption by non-aerated suspensions, and with a high consumption value after aeration. A relation that permits calculation of the risk factor has been derived, and the different risk factor ranges have been assigned to five defined risk groups. The results of risk assessment indicate that soft, liquid sludge and typical mud may fall within group 3 (medium risk), but they should be preponderantly classed in groups 1 and 2 (low risk). Sediments with muddy-sandy character are generally without risk. (Airone-PTT)
W88-04352

COMPARISON OF SIMPLE METHODS FOR ESTIMATING THE MASS FLOW OF FLUORIDE DISCHARGED INTO RIVERS,
Antwerpse Waterwerken (Belgium). Labs. Dept.
W. Van Craenenbroeck, and J. Marivoet.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 729-740, 1987. 7 fig, 2 tab, 18 ref.

Descriptors: *Path of pollutants, *Meuse River, *Fluorides, *Rivers, Flow profiles, Comparison studies, France, Netherlands, Mathematical studies, Pollution load, Water pollution sources.

The long term evolution of the pollutant discharge pattern in the Meuse River was investigated. The behavior of the fluoride concentration in the river Meuse is presented for the river stretch between Remilly (France) to Keizersveer (Netherlands), over the period 1970-1984. Data from wastewaters and tributaries are discussed, and a phosphate fertilizer factory near Liege is identified as a dominating fluoride source. A linear first order equation is proposed for fitting the C-Q data at Liege (Belgium). Five methods for estimating the mean fluoride mass flow of the discharge were compared. The weighted least squares method is proposed for further use. It makes use of data from a routine measuring station, and gives the possibility to estimate a natural concentration which is constant over the period studied (1970-1984). The obtained value of 0.19 mg/L is equal to the mean fluoride concentration upstream of the discharge point. The estimated discharge mass flow is about 6 tons/day; this value has remained constant since 1979. (Author's abstract)
W88-04358

STUDY ON REAERATION IN RIVER CASCADES,
M. Von Sperling.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 757-767, 1987. 5 fig, 5 tab, 9 ref.

Descriptors: *Rivers, *Water quality, *Reaeration, *Cascades, Gas transfer, Mathematical models, Oxygen, Biological oxygen demand, Dissolved oxygen, Arrudas River, Brazil.

The Arrudas River, Brazil, cascades represent an efficient mechanism for gas transfer, providing the introduction of significant amounts of oxygen into the polluted river water. Studying the reaeration in the falls, it was seen that the use of theoretical formulae available in the literature did not represent well the real experimental results. The development of an empirical model based on a series of intensive field and laboratory works led to very good agreement between observed and calculated values of the dissolved oxygen concentration downstream of the cascades. BOD removal under these conditions was negligible. The use of the model in two other different cascades showed an acceptable accuracy, suggesting that in a preliminary way, the derived model may be applied for natural cascades with a similar configuration to those in the Arrudas River. More research on this topic is still needed before the general applicability of the model to a wider range of river cascades may be assumed. (Lantz-PTT)
W88-04360

MODELING OF BIOLOGICAL PROCESSES IN THE SUBSURFACE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
E. J. Bouwer, and G. D. Cobb.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 769-779, 1987. 4 fig, 2 tab, 33 ref.
NSF Grant No. CEE-8404349.

Descriptors: *Model studies, *Groundwater pollution, *Path of pollutants, Solute transport, Organic compounds, Biofilms, Biotransformation, Aquifers, Oxidation, Nitrification, Denitrification, Sulfates, Methanogenesis.

Biofilm processes are potentially important for transformations of organic micropollutants in groundwater. The type of electron acceptor used by the microorganisms is an important environmental factor affecting biotransformation. A fundamental model of biofilm kinetics is shown to be capable of simulating microbially-mediated changes in a subsurface system of primary substrates and mixed electron acceptors. The model incorporates external mass transport effects, Monod kinetics with determination of limiting electron donor or acceptor, and competitive and sequential microbial reactions. The system to which the model is applied includes aerobic carbonaceous oxidation, nitrification, denitrification, sulfate respiration, and methanogenesis. The model established the dominant electron acceptor condition in a given region so that favorable environments for organic contaminant biotransformation can be determined. Model simulations could suggest strategies to achieve aquifer clean-up with biological processes. (Author's abstract)
W88-04361

SURVEY FOR SALINITY INTRUSION AND POLLUTION ASSESSMENT IN MAPUTO ESTUARY,
Universidade Eduardo Mondlane, Maputo (Mozambique). Dept. of Civil Engineering.
J. M. Salomao.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 823-832, 1987. 10 fig, 5 tab, 19 ref.

Descriptors: *Water pollution sources, *Saline water intrusion, *Estuaries, *Water quality, *Maputo Estuary, *Mozambique, Monitoring, Dissolved oxygen, Salinity, Permeability coefficient, Water temperature, Mixing, Nitrogen, Phosphorus, Fate of pollutants.

A survey of Maputo estuary, to acquire data required to characterize the estuary was carried out in December 1983. After reviewing the hydrology of the tributaries to the estuary, the parameters to be monitored - salinity, conductivity, temperature, and dissolved oxygen, are discussed. The estuary can be classified as well mixed, since the vertical salinity gradients are small. The Umbeluzi estuary, however, is partially mixed. Temperature decreases with depth, and when moving downstream. Some pollution was found along the lower part of the estuary, probably due to the discharge of domestic and industrial wastewater, which brings the dissolved oxygen figures below the saturation level. As for the upper part of the estuary, the dissolved oxygen levels are not only dependent on the pollutant load, but also on the growing of algae, which by photosynthesis under daylight produce oxygen that dissolves into the water. Quite often, the dissolved oxygen figures are above the saturation level. The growth of algae could be due to the input of phosphorus and nitrogen brought in by the tributary streams. A pollutant load discharged upstream could be the reason for some pollution seen in the Umbeluzi estuary. (Author's abstract)
W88-04366

EVALUATION OF HEAVY METAL LEACHABILITY FROM SOLID WASTES,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
T. R. Bridle, P. L. Cote, T. W. Constable, and J. L. Fraser.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 1029-1036, 1987. 6 fig, 3 tab, 20 ref.

Descriptors: *Heavy metals, *Leachability, *Solid wastes, *Water pollution sources, *Land disposal, Waste disposal, Cadmium, Zinc, Nickel, Copper, Fly ash, Path of pollutants.

Future management options for residual inorganic solid wastes are likely to include land disposal. While the environmental ramifications of this option are now better understood, additional data is required to permit a thorough assessment of contaminant leachability from solid wastes. As part of this data gathering exercise, Environment Canada's Wastewater Technology Centre has been actively researching and developing test methods designed to measure intrinsic waste properties that affect contaminant leachability, such as metal solubilities and speciation. Based on this approach, the leachability of heavy metals from sewage sludge, char and ash, municipal solid waste ashes, hazardous waste incinerator fly ashes, power plant ashes and a solidified synthetic waste were assessed. The results indicate that incineration of sewage sludge produces a benign ash with most of the metals speciated as insoluble oxides or silicates. By contrast, incineration of municipal solid waste or hazardous waste produces fly ashes exhibiting significant metal leachability. Environmentally sensitive metals such as Cd, Zn, Ni and Cu in these fly ashes were readily leachable and probably speciated as water soluble chloride salts. The intrinsic properties approach appears to be an effective method of assessing waste leachability. (Author's abstract)
W88-04386

FLOW OF SURFACE BUOYANT JET IN CROSS FLOW,
Hydrological Research Unit, Wallingford (England).
H. O. Anwar.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 7, p 892-904, July 1987. 9 fig, 1 tab, 13 ref, append. Department of the Environment (UK) Contract No. PECD7/7/050.

Descriptors: *Mixing, *Path of pollutants, *Outfall, *Surface waters, *Jets, *Cross flows, Wastewater disposal, Flow patterns, Hydraulic characteristics, Flow velocity, Water temperature.

A laboratory study was conducted to determine the flow parameters of a rectangular surface jet discharging normally onto a cross flow. The Reynolds numbers of the buoyant jet and the cross flow are 110,000 and 70,000, respectively, with a densimetric Froude number of 1.7 and a ratio of ambient velocity to jet velocity of 0.9. Vertical and horizontal isotherms were determined, and it was found that the jet axis is strongly depth-dependent. Profiles of the mean velocity and the temperature turbulence intensity were measured at various downstream sections. Lateral profiles of the temperature flatness factor, skewness factor, temperature length scale, and the warm water flux were measured at one cross section. The maximum of the temperature turbulence intensity occurred where the lateral gradient of the mean temperature profile was the maximum. The turbulence intensity was appreciable at the outer edge where the jet temperature was very close to that of the ambient cold water. The maximum of the turbulent warm-water flux in the mean flow direction occurred between the jet axis and the outer edge of the jet. (Lantz-PTT)
W88-04390

PERFORMANCE EVALUATION OF SURFACE WATER TRANSPORT AND DISPERSION MODELS,
Argonne National Lab., IL.
J. D. Ditmars, E. E. Adams, K. W. Bedford, and D. E. Ford.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 961-980, August 1987. 7 fig, 37 ref.

Descriptors: *Path of Pollutants, *Surface waters, *Hydrologic models, *Dispersion, *Model studies, Performance evaluation, Flow properties, Flow profiles.

The procedures required to evaluate the performance of an analytical or numerical surface water model, were identified, collated, and defined. The essential elements are: Identification of the problem; relationship of the model to the problem; solution scheme examination, model response studies, model calibration; and model validation. Codification was not attempted, rather literature examples were used to define the techniques that have been used to address each of these elements. Emphasis in the six elements is placed on moving the evaluation of models, particularly those in journal publications, towards more quantitative or objective measures of calibration and validation. Also recognized, however, is that such objective measures can only be meaningful when placed in context with all the performance elements. (Author's abstract)
W88-04392

TWO-DIMENSIONAL BUOYANT JETS IN TWO-LAYER AMBIENT FLUID,
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
R. B. Wallace, and B. B. Sheff.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 992-1005, August 1987. 8 fig, 2 tab, 15 ref, append.

Descriptors: *Mixing, *Dispersion, *Path of pollutants, *Outfall, *Plumes, *Buoyant jets, *Flow profiles, *Mathematical analysis, Hydraulic properties, Fluid dynamics, Density, Mathematical studies, Wastewater disposal.

Dimensional analysis was used to obtain asymptotic solutions that describe plume behavior in a two-layer ambient fluid. A single dimensionless parameter measures the ability of the density discontinuity to stop plume rise. Experiments showed the range of values of the parameter that define conditions for weak and strong density discontinuities. Constants were determined from the experimental data, which allow quantitative prediction of some spreading layer characteristics. The results could be used to estimate the minimum dilution produced by an ocean outfall diffuser for those stratifications that could reasonably be approximated with the two-layer assumption. (Lantz-PTT)
W88-04394

INFLUENCE OF SURFACE WAVES ON OUTFALL DILUTION,
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
For primary bibliographic entry see Field 5E.
W88-04395

TWO-DIMENSIONAL NUMERICAL MODEL OF THERMAL DISCHARGES IN COASTAL REGIONS,
Camp, Dresser and McKee, Inc., San Francisco, CA.
S. H. Chieh.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 1032-1040, August 1987. 7 fig, 18 ref.

Descriptors: *Mathematical models, *Thermal pollution, *Path of pollutants, *Coastal waters, Model studies, Pollutant transport, Water temperature, Mapping, Red Sea.

A two-dimensional numerical model of thermal discharge in coastal regions uses potential flow theory to calculate the ambient velocity field of the coastal water. Using the calculated velocity field, the heat transport equation was solved to define the excess temperature field. The finite difference method for arbitrary boundary shapes was used to solve the stream function for the current velocity calculation and the two-dimensional heat transport equation for the excess temperature calculation. To illustrate the computational procedure, the model was applied to the case of a recently developed industrial complex in the Red Sea region. The power and desalination plants of the industrial complex require a large amount of seawater for cooling purposes. The used cooling water is discharged into the Red Sea. Hypothetical values for the various parameters were used in this case study. The model was run on a VX-11/730

minicomputer. The case study demonstrates the usefulness of the stream function to obtain the velocity field. It also demonstrates that the model can provide a first approximation of the temperature field. Therefore, the use of the model is justified where field data are not readily available. (Author's abstract)
W88-04397

UPPER JAMES ESTUARY - A STUDY IN WATER QUALITY MANAGEMENT,
Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 5G.
W88-04412

WATER QUALITY CONTROL PLAN FOR WEST MORAVA RIVER BASIN IN YUGOSLAVIA,
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 5G.
W88-04413

MONITORING OF HEAVY METALS IN THE WATER AND SEDIMENTS OF THE GANGA RIVER, INDIA,
Aligarh Muslim Univ. (India). Chemistry Section.
M. Ajmal, M. A. Khan, and A. A. Nomani.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 107-117, 1987. 1 fig, 4 tab, 36 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Fluvial sediments, *Monitoring, *India, *Stream pollution, Rivers, Spectrophotometry, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Nickel, Lead, Zinc, Hydrogen ion concentration, Calcium carbonate, Organic matter, Potassium, Phosphorus, Fate of pollutants, Sediment contamination.

The concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn in the water and sediments of the Ganges River were determined by atomic absorption spectrophotometry in 1981. The respective ranges of concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn found in the water were ND-0.53, ND-4.89, 3.20-56.6, ND-27.57, 22.0-133.8, 35.0-93.0, ND-2.22, 2.0-5.6, and 7.37-67.36 micrograms/liter and in the sediments were ND-3.48, 2.35-14.4, 9.0-83.16, 11.27-95.0, 2168.0-11624.8, 110.5-470.0, 3.45-28.80, 0.55-21.8 and 72.0-418.6 micrograms/gram. The data showed that there was considerable variation in the elements from one sampling station to the other. The sediments collected from different sampling stations were also analyzed for pH, calcium carbonate, organic matter, potassium, and phosphorus. (Author's abstract)
W88-04423

SOURCES OF HEAVY METALS AND THEIR IMPACTS ON WASTEWATER TREATMENT AND RECEIVING WATER BODIES' QUALITY - CASE STUDY OF A METROPOLITAN AREA,
Pratt Inst., Brooklyn, NY.
C. Yapijakis, and F. Papamichael.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 133-144, 1987. 10 tab, 14 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Electroplating, *Water pollution effects, *Water quality, *New York, Wastewater treatment, Case studies, Cadmium, Copper, Chromium, Nickel, Lead, Zinc, Mercury, Industrial wastes, Sludge disposal, Path of pollutants.

In accordance with the US EPA General Pretreatment Regulations, New York City has conducted a comprehensive study to establish a local industrial pretreatment program. Heavy metals (Cu, Cr, Pb, Ni, Zn, Cd, and Hg) were the only priority pollutants found to be consistently present in the wastewater, with the electroplating industry as the major contributor. Heavy metals do not affect the performance of the treatment plants, as their levels at all plants are below the reported threshold limits. However, the existing levels of heavy metals found in New York City sludges limit its disposal options. Pretreatment can significantly decrease the amounts of Cr, Ni, and Cd discharged into the Harbor by New York City treatment plants, although only 17% of the sludges would be suitable for agricultural land application. (Geiger-PTT)
W88-04426

OPTIMIZATION OF REGIONALIZED WASTEWATER TREATMENT SYSTEMS FOR THE RIVER AVE BASIN,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 5D.
W88-04429

COMPARATIVE ANALYSIS OF IRON, MANGANESE, SILICA, PHOSPHORUS, AND SULFUR IN THE HYPOLIMNIA OF CALCAREOUS LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W88-04440

COMPARISON OF GEOSTATISTICAL METHODS FOR ESTIMATING VIRUS INACTIVATION RATES IN GROUND WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W88-04451

ISOTOPICALLY EXCHANGEABLE PHOSPHATE IN FRESHWATER SEDIMENTS: EFFECTS OF U. V.-IRRADIATION, FORMALDEHYDE, SOLID/SOLUTION RATIO, AND PH ON ITS EXPERIMENTAL DETERMINATION,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geochemistry.
L. H. Vaas, R. N. J. Comans, H. A. Das, J. M. M. Reith, and C. H. van der Weijden.
Water Research WATRAG, Vol. 21, No. 9, p 1135-1142, September, 1987. 2 fig, 6 tab, 29 ref.

Descriptors: *Path of pollutants, *Formaldehyde, *Phosphates, *Lake sediments, *Fluvial sediments, *Ultraviolet radiation, *Hydrogen ion concentration, Eutrophication, Water quality, Nutrients, Radioactive tracers, Absorption, Chemical reactions.

The influence of bioactivities, solid/solution ratio and pH on the isotopic exchangeability of phosphate in freshwater sediment was investigated. Comparison of the results obtained for the same sample in the presence or absence of formaldehyde, concluded that microorganisms can effect the analysis for isotopically exchangeable phosphate. Irradiation with u.v.-light caused a sharp rise in isotopic exchangeability. In the pH-range 6.6-8.4 isotopic exchangeabilty of phosphate increases with decreasing pH-value, attributed to an easier exchange of H2PO4(-) than of HPO4(2-). The influence of the solid/solution ratio on the isotopic exchangeability of phosphate in the solid phase is small or nil. However, because of the relatively large amount of phosphate that goes into solution, the total isotopic exchangeability of phosphate in the solid and liquid phase together is strongly increased at a low solid/solution ratio. From these results it is concluded that in order to make a meaningful comparison of isotopically exchangeable phosphate in different soils or sediments it is essential to work at a nearly constant pH and solid/solution ratio. Such a comparison was made for 26 freshwater sediments from the Rhine/Meuse delta, in the presence and absence of 0.17 mol/liter formaldehyde as a biological inhibitor; it is concluded that addition of the latter is essential. The lowest total isotopic exchangeabilities of phosphate, (15-25) were measured in sediments collected from the Haringvliet; high values (40-80) were found in the sediments from the Brielse Meer and the Grote Rug. This could well be indicative of a similar variance in the biological availability of phosphate in the investigated sediments. (Author's abstract)
W88-04453

MODAL RESPONSE OF RESERVOIRS TO WIND STRESS,
Stanford Univ., CA. Dept. of Civil Engineering.
S. Monismith.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1290-1306, October 1987. 10 fig, 4 tab, 28 ref, append. Univ. of California Water Resources Center Project No. UCAL-WRC-W592.

Descriptors: *Reservoirs, *Seiches, *Path of pollutants, *Wind stress, *Wind-driven currents, *Density stratification, Stratification, Hydraulic properties, Mathematical studies, Shear stress, Upswelling.

The response of a density-stratified reservoir to surface shear stress was analyzed. The reservoir is assumed to be two-dimensional and to have a constant depth. In the limit that the bulk Wedderburn number W sub B and the bulk Richardson number Ri sub B are both infinite, the resulting equations are linear and solutions can be found in terms of the individual responses of a set of orthogonal normal modes. For the case of a steady wind stress, the solution consists of periodic motions and steady isopycnal displacements. However, the steady-state isopycnal slope at the base of the mixed layer is infinite, implying that upwelling can occur when the Wedderburn number is quite large. This is attributed to blocking of the stratified fluid below the mixed layer by the endwall. The modal theory was compared with experimental observations made using a belt to impart shear stress to a stratified fluid contained in a box. The comparison showed that the theory is qualitatively correct in that upwelling is observed when W sub B $>>$ 1. However, the modal theory best predicts the first-model seiche amplitude; the higher-mode response is not accurately predicted. (Author's abstract)
W88-04465

MACRODISPERSION IN STRATIFIED POROUS MEDIA,
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
D. A. Chin.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1343-1358, October 1987. 7 fig, 16 ref, append.

Descriptors: *Path of pollutants, *Porous media, *Density stratification, *Groundwater pollution, *Dispersion, Mathematical studies, Stratification, Flow profiles.

A methodology was developed in which field data on spatial variations in the hydraulic conductivity and local dispersivity are used to determine the macrodispersion coefficient tensor of the formation. This technique was applied to an idealized stratified formation, and the relative importance of several nondimensional parameters that influence the macrodispersivity were studied. For several flows parallel to the stratification, the macrodispersivity may be several orders of magnitude greater than the local dispersivity. This effect is significantly reduced as the flow direction is rotated. In utilizing the macroscopic advection-dispersion equation, it was shown that the macrodispersion coefficient may be dependent on grid scale, source location, and flow direction, although scale and source dependence will generally disappear as the grid scale becomes very large. (Author's abstract)
W88-04468

5C. Effects Of Pollution

ALGAL GROWTH POTENTIALS AND HEAVY METAL CONCENTRATIONS OF THE PRIMARY STREAMS TO UPPER BEAVER LAKE.
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5B.
W88-03502

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 2: ENVIRONMENT, HEALTH, AND RISK.
Proceedings of the Fourth Conference on Water

Chlorination: Environmental Impact and Health Effects, Pacific Grove, California, October 18-23, 1981. Ann Arbor Science, Ann Arbor, MI. 1983. 2 v. (1491 p). Edited by Robert L. Jolley, William Brungs, Joseph A Cotruvo, Robert B. Cumming, Jack S. Mattice, and Vivian A. Jacobs.

Descriptors: *Water pollution effects, *Chlorination, *Water treatment, *Mutagens, Aquatic habitats, Cooling water, Invertebrates, Fish, Toxicity, Cancer, Disinfection, Wastewater treatment, Fate of pollutants, Chlorinated hydrocarbons, Organic compounds, Powerplants, Ozonation, Thermal pollution, Pathogens, Viruses, Bacteria, Chlorine dioxide, Chloramines, Trihalomethanes, Pollutant identification, Groundwater, Surface water, Public health, Water supply, Risks, Bromine compounds.

This collection of papers concerns several aspects of chlorination of water and wastewater: (1) its effects on the aquatic ecosystem, especially with respect to powerplant cooling waters discharged into saline water, (2) disinfection (mechanisms, efficacy, health and environmental effects), (3) mutagenicity and carcinogenicity, (4) effects on humans, with emphasis on epidemiological studies of cancer, and (5) risk assessment methods. Intermittent chlorination of cooling water is less harmful to marine organisms than continuous chlorination. Excess sodium thiosulfate used in dechlorination has long-lasting harmful effects. Toxicity data or bioaccumulation data are reported for fish (mosquitofish, mullet, Chromis punctipinnis, menhaden, bluegill, blue rockfish) and for invertebrates. The action of disinfectants on viruses, bacteria, and amoeba is reported. 3-Chloro-4,4'-dimethyl-2-oxazolidinone and bromine chloride are safe, effective disinfectants. Ammonia in wastewater effluents appeared to improve the disinfection efficiency of chlorine. Mutagenicity has been detected in drinking water concentrates with emphasis on halogenated organic compounds formed from the reaction of the disinfectant with organic matter in the raw water. Mutagens are found more often in chlorinated surface water than in chlorinated groundwater. Reverse osmosis removes mutagenic electophilic compounds more readily than distillation. Ozonation is less likely to produce mutagens than chlorination; continued oxidation usually decomposes the mutagens. Bladder and rectal cancers are associated with higher levels of chlorinated compounds in drinking water. (Cassar-PTT)
W88-03505

INTERACTION OF AQUATIC ECOSYSTEM COMPONENTS WITH CHLORINATION: AN OVERVIEW,
Environmental Research Lab., Gulf Breeze, FL.
W. P. Davis, and J. A. Fava.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 791-796, 18 ref.

Descriptors: *Water pollution effects, *Chlorination, *Aquatic habitats, Disinfection, Planning, Wastewater treatment, Pollutant identification, Monitoring, Regulations.

Although chlorination of water, particularly wastewater, is increasing in the United States, serious consideration has been given to banning chlorination for disinfection because of potential ecological damage and potential adverse effects on humans. A holistic approach is recommended in determining the optimum use of chlorination. Recent studies have added to the body of knowledge necessary to make decisions concerning chlorination. This includes toxicity of aquatic plants and animals, improvements in analytical technology, reaction of complex aquatic communities, and dechlorination technology. The question still remains: Is the current data base sufficient to make educated technical decisions, or is more focused research required. Decisions must be made based on existing information; testing and evaluation must continue. Long-range concepts of the basic problem must be incorporated into thinking and planning. (Cassar-PTT)
W88-03506

LONG-RANGE CHLORINATION IN OPEN MICROCOSMS: INTERPRETATIONS,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. R. Vanderhorst, J. R. Bridge, and G. W. Fellingham.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 797-809, 8 fig, 1 tab, 11 ref.

Descriptors: *Water pollution effects, *Water treatment, *Chlorination, *Aquatic habitats, Invertebrates, Algae, Diatoms, Crustaceans, Mollusks, Polychaetes, Seawater, Marine invertebrates.

Long-range effects of chlorination on marine epibenthic communities were studied for two years using concrete substrates. Treatments were: (1) control, (2) intermittent chlorination three times daily for 30 min at 10 ppb chlorine-produced oxidants, (3) intermittent chlorination three times daily for 30 min at 50 ppb chlorine-produced oxidants, (4) continuous chlorination at 10 ppb chlorine-produced oxidants, and (5) continuous chlorination at 50 ppb chlorine-produced oxidants. Tanks contained seawater at 32 ppt salinity and natural populations of marine organisms. Species richness increased in all treatments. However, growth was slower in continuous treatments than in intermittent treatments, which did not differ significantly from the control. Growth was also slower in the 50-ppb treatment than in the 10-ppb treatment. After the sixth month of exposure diatom coverage of the concrete surface showed differences among the treatments; the continuous 50-ppb treatment clearly had the lowest percent coverage. The decrease in diatoms coincided with an increase in limpets. The estimated time for development of a mature community was 70 months. (Cassar-PTT)
W88-03507

CHLORINE-HEAVY METALS INTERACTION ON TOXICITY AND METAL ACCUMULATION,
Envirotest, Redmond, WA.
D. R. Anderson.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 811-826, 7 tab, 17 ref.

Descriptors: *Water pollution effects, *Water treatment, *Chlorination, *Aquatic habitats, *Metals, Fish, Trout, Nickel, Synergistic effects, Bioaccumulation, Accumulation, Toxicity.

Chlorine and nickel produced a synergistic toxic reaction in rainbow trout. Mortality in chlorine-nickel test groups was significantly greater than predicted by an additive interaction. Two trends were apparent. (1) In each test the chlorine-nickel treatment groups with high chlorine concentrations relative to other treatment groups in the test, regardless of the nickel level, had higher mortality rates than chlorine-nickel treatment groups with low chlorine concentrations. (2) Chlorine-nickel treatment groups with the low chlorine concentration relative to the other treatment groups in that test, regardless of nickel concentration, showed greater percentage mortality than treatment groups with either nickel or chlorine alone. Nickel concentrations in fish tissue were higher in fish exposed to both chlorine and nickel than from fish exposed only to nickel. (Cassar-PTT)
W88-03508

PHYSIOLOGICAL EFFECTS OF CHLORINE-PRODUCED OXIDANTS, DECHLORINATED EFFLUENTS, AND TRIHALOMETHANES ON MARINE INVERTEBRATES,
Research Planning Inst., Inc., Meggett, SC.
G. L. Scott.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 827-841, 3 tab, 21 ref.

Descriptors: *Water pollution effects, *Water treatment, *Chlorination, *Aquatic habitats, Invertebrates, Bromoform, Trihalomethanes, Sodium thiosulfate, Dechlorination, Seawater, Marine invertebrates, Toxicity, Stress, Oxidation, Cooling water, Wastewater treatment, Literature review, Oysters, Accumulation, Bioaccumulation, Chlorinated hydrocarbons.

A literature review indicates that chlorination, dechlorination, and trihalomethane production can significantly affect marine invertebrate physiology. In general, chlorination produces the greatest amount of physiological stress. Much of this is irreversible after 16 days of depuration. Exposure to dechlorinated effluents produces significant physiological effects, but most are reversible after 16 days of depuration, except for oyster condition and gondola indexes. Exposure to excess thiosulfate also produces significant physiological stress, most of which is irreversible after 16 days of depuration. Exposure to bromoform produces significant physiological stress during chronic exposure and slight bioaccumulation. However, after 16 days of depuration most physiological problems were resolved, except for oyster condition and gonadal indexes. Dechlorination of chlorinated effluents at exactly 1:1 chlorine:sodium thiosulfate would significantly decrease the degree to toxicity and stress compared with chlorination alone. However, excess thiosulfate also causes stress, most of which is long lasting. (Cassar-PTT)
W88-03509

TOTAL RESIDUAL CHLORINE AS A REGULATORY TOOL,
Oak Ridge National Lab., TN.
J. S. Mattice, and S. C. Tsai.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 901-912, 1 fig, 4 tab, 18 ref.

Descriptors: *Water pollution effects, *Water treatment, *Cooling water, *Chlorination, *Powerplants, Electric powerplants, Organic compounds, Chloramines, Residual chlorine, Fish, Mosquitofish, Toxicity.

The toxicities of inorganic chloramines and mixtures with free chlorine were determined using mosquitofish, Gambusia affinis. The LC50 (mg/L) for a 1-hour exposure of the compounds, expressed as total residual chlorine were as follows: monochloramine, 1.31; dichloramine, 0.366; hypochlorous acid, 0.455; hypochlorite ions, 2.21; 88:12 mono- and dichloramine mixture, 1.103; and 67:28:2:3 mixture of monochloramine:dichloramine:hypochlorous acid:hypochlorite, 0.794. Preliminary assumptions are that the toxicities of residual chlorine species are additive. However, some organic chloramines are known to have LC50 as high as 575 mg/L. Therefore, additivity of residual chlorine species could be used as a regulatory method if structure-activity relationships are clarified and if the species formed in effluents are clearly defined. (Cassar-PTT)
W88-03513

FACTORS IN THE DESIGN OF CHLORINE TOXICOLOGICAL RESEARCH,
Ecological Analysts, Inc., Sparks, MD.
J. A. Fava, and G. L. Seegert.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 913-926, 1 tab, 31 ref.

Descriptors: *Water pollution effects, *Chlorination, *Toxicity, *Data interpretation, Research priorities, Chemical analysis, Water analysis, Pollutant identification, Accuracy, Precision, Water quality, Field studies.

An evaluation criteria matrix has been developed for critically reviewing data for inclusion into or exclusion from a toxicological data base. The matrix includes four categories: analytical methodology, experimental method, factors affecting chlorine toxicity, and analysis and interpretation. Each category is subdivided into level 1 or level 2 criteria. Data passing level 1 criteria are further

evaluated by level 2 criteria, which are more subjective. Under analytical methodology certain methods are automatically rejected in level 1. Level 2 considers accuracy and precision, level of detection, and interferences. Under the experimental methods category level 1 criteria look at test apparatus and species selection; level 2 considers condition and acclimation of test organisms, general dilution water quality, and volume of test solution. Under the factors affecting chlorine toxicity no level 1 criteria exist; level 2 criteria consist of water quality factors, chlorine species, estimate of variability for water quality parameters, field studies, and biological factors. Likewise, only level 2 criteria exist for the analysis and interpretation category--type of data analysis, estimate of variability, data transformation, extrapolation, and applicability. (Cassar-PTT)
W88-03514

CHLORINE TOXICITY AS A FUNCTION OF ENVIRONMENTAL VARIABLES AND SPECIES TOLERANCE,
Ebasco Services, Inc., New York.
A. Turner, and A. Chu.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 927-945, 5 tab, 58 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cooling water, *Powerplants, *Aquatic habitats, Regulations, Toxicity, Electric powerplants, Estuarine environment, Marine environment, Effluent limitations, Residual chlorine, Temperature effects, Saline water, Alkalinity, Hardness, Hydrogen ion concentration.

Chlorine biosssay data were analyzed statistically. Several conclusions were reached. The toxicity of total residual chlorine in fresh water was a function of the relative abundance of free residual chlorine and combined residual chlorine in the discharged effluents. The higher the percentage of free residual chlorine, the more toxic the effluent. Increased pH resulted in decreased total residual chlorine toxicity. Increased alkalinity resulted in increased LC50 values. Salinity affected biological response to exposure of chlorine additions; for unknown reasons chlorine was more toxic in water of higher salinity. Toxicity of chlorinated effluents increased with increased temperature in fresh water. Vertebrates and invertebrates responded differently to chlorine exposure in fresh water and in marine-estuarine habitats; species differences were also noticeable. These conclusions affect current and proposed effluent limitations. Since the current regulations limit only discharge of free residual chlorine/halogen, they do not account for synergistic effects of combinations of chlorine compounds. Proposed effluent regulations indicate a 2-hour chlorination period per 24 hours, precluding continuous chlorination at reduced chlorine concentrations. Present and proposed regulations do not recognize that the toxic effect of chlorinated effluents is slightly less severe in saline than in freshwater habitats. (Cassar-PTT)
W88-03515

EFFECTS OF CHLORINATED DISCHARGES ON MARINE ANIMALS,
Gulf Coast Research Lab., Ocean Springs, MS.
A. Venkataramiah, G. L. Lakshmi, C. M. Best,
and, G. Gunter, and E. O. Hartwig.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 947-966, 5 fig, 8 tab, 20 ref. Contract No. ET-78-S-02-507. A000.

Descriptors: *Water pollution effects, *Chlorination, *Fish, Mullet, Cooling water, Toxicity, Marine animals, Sea water, Bioassay.

Bioassay tests of chlorine in seawater were conducted on mullet of 0.3 g average weight. In acute tests (96 hr) the 100% mortality > or = 0.298 ppm total residual oxidant (TRO); the 0% mortality, < or = 0.151 ppm TRO. The LT50 and LT100 decreased to 2.1 and 3.3 hours, respectively, at the highest TRO dose of 1.5 ppm (corresponding to 3.62 ppm dosed chlorine). In 21-day chronic bioassays with 1.1-g mullet no mortality was seen until 0.273 ppm TRO (1.66 ppm dosed chlorine). At 0.274 ppm TRO (1.89 ppm dosed chlorine) mortality was 93%, and LT50 was 2 days. At high TRO concentrations (0.273 and 0.274 ppm) mullet were generally inactive, some showed signs of heavy stress, and most stayed at the bottom of the tanks. Opercular movements were rapid. Some fish gasped for breath. A few were turned upside down. Growth was 41% lower than in the controls. The 10.0-g mullet were nearly three times more resistant to TRO than 0.3-g mullet, with LC50 values of 0.607 and 0.212 ppm, respectively. The 10.0-g mullet survived more than three times longer than 0.3-g mullet in their respective LC50 TRO concentrations. (Cassar-PTT)
W88-03516

DOES AVOIDANCE OF CHLORINATED SEAWATER PROTECT FISH AGAINST TOXICITY. LABORATORY AND FIELD OBSERVATIONS,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
J. E. Hose, T. D. King, K. E. Zerba, R. J. Stoffel, and J. S. Stephens.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 967-982, 2 fig, 3 tab, 33 ref.

Descriptors: *Water pollution effects, *Chlorination, *Fish, *Cooling water, Powerplants, Toxicity, Fish behavior, Behavior, Plumes, Temperature, Blood, Fish physiology.

Fish movements were monitored during three experimental chlorinations of powerplant discharges. Plumes temperatures were 25.5-29.0 C compared with the temperature around the discharge base, 14.5-23.3 C. Thirteen species of fish were observed in the discharge area before chlorination. Fish did not avoid the chlorinated plume at total residual oxidant (TRO) concentrations of 0.10 to 0.14 mg/L. However, when TRO concentrations exceeded 0.20 mg/L, all fish left the plume. When TRO concentrations dropped below 0.20 mg/L, fish reentered the plume. Divers did not observe mortalities at any time. After treatment with 0.01 mg/L TRO for 30 min, subadult Chromis punctipinnis showed an 8% increase in plasma osmolarity and 62% increase in Mg(++). Plasma Ca(++) and blood pH were unaffected. The classical histological signs of chlorine toxicity were evident--separation of squamous respiratory epithelium, gill edema, and hemorrhages in gill lamellae and kidney. In addition, spherical eosinophilic nodules were present within gill lamellae. Hemotological responses included hemolysis, microcytosis, and release of immature erythrocytes into the peripheral circulation. (Cassar-PTT)
W88-03517

AVOIDANCE RESPONSES OF JUVENILE ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, SUBJECTED TO SIMULTANEOUS CHLORINE AND DELTA T CONDITIONS,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, S. L. Margrey, W. C. Graves, and D. T. Burton.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 983-991, 2 fig, 1 tab, 18 ref.

Descriptors: *Water pollution effects, *Cooling water, *Chlorination, *Thermal pollution, *Fish, Temperature effects, Fish behavior, Behavior, Plumes, Toxicity, Atlantic menhaden, Menhaden, Residual chlorine.

The avoidance responses of juvenile Atlantic menhaden, Brevoortia tyrannus, to simultaneous elevated temperature (0, 2, 4, and 6 degrees C) and total residual chlorine (TRC) (0.000, 0.05, 0.10, and 0.15 mg/L) conditions at summer acclimation temperatures of 25 and 30 C were determined in the laboratory. Two three-dimensional response surfaces were developed to predict the avoidance responses at 25 and 30 C. The response surface developed at 25 C showed that (1) there was no position effect in the test unit, (2) avoidance increased with increasing TRC concentrations at each temperature difference condition, (3) avoidance increased with increasing temperature difference conditions at each TRC concentration, (4) greatest avoidance (about 87%) occurred at a temperature difference of 6 C and 0.15 mg/L TRC, and (5) TRC was the most important factor causing avoidance. The response surface developed at 30 C showed that (1) there was no position effect in the test, (2) greater than 84% avoidance occurred at all 2 C temperature difference conditions at all TRC concentrations, (3) avoidance of >80% occurred at temperature differences of 4 and 6 C at zero TRC or greater, (4) greater than 93% avoidance occurred at temperature differences of 4 and 6 C at all TRC concentrations, and (5) temperature differences and TRC were both important factors influencing avoidance. A significant difference between avoidance models occurred at acclimation temperatures of 25 and 30 C; greater avoidance occurred at all combinations at the higher acclimation temperature. (Cassar-PTT)
W88-03518

HEMATOLOGICAL RESPONSES OF BLUEGILL TO CHLORINATION AND TEMPERATURE TESTS AND TO AN OPERATING POWER PLANT,
Tennessee Valley Authority, Muscle Shoals, AL.
S. A. Murray.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 993-1004, 9 tab, 20 ref.

Descriptors: *Water pollution effects, *Cooling water, *Chlorination, *Thermal pollution, *Fish, Temperature effects, Toxicity, Fish physiology, Powerplants, Bluegills, Blood.

The effects of chlorination and temperature on bluegill hematology were studied in the laboratory and at an operating powerplant. In the laboratory studies 0.2 mg/L chlorine was added each day; this was converted to monochloramine and the concentration reduced to zero with 3-4 hours. The concentration of total residual chlorine in the powerplant discharge channel was about 0.10 mg/L. In the laboratory studies no correlations between fish length and any hematological variable was found. The hemotological responses associated with high temperature (20 C) vs. ambient temperature of 12.4 C were characterized by decreased levels for mean erythrocytic hemoglobin concentration (by 11%) with no change in overall hemoglobin, rounder red blood cells (by 11%) with a compensating change in cell length (by 7%), and trombocytopenia (by 3%) with a concomitant lymphocytosis (by 37%). Seven of the 16 hematological variable accounted for 80% of the total variation. In the laboratory chlorination tests (1) hemoglobin levels were decreased by 13% and hematocrit by 17% and (2) red blood cells increased in size (length by 4%, width by 6%). In the field tests chlorine concentrations were apparently not high enough to impact bluegill hematology. Cell roundness appeared to be the best indicator variable, accounting for 19.42% of the total variation. (Cassar-PTT)
W88-03519

PREDICTED MORTALITY OF CHESAPEAKE BAY ORGANISMS EXPOSED TO SIMULATED POWER PLANT CHLORINATION CONDITIONS AT VARIOUS ACCLIMATION TEMPERATURES,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, D. T. Burton, S. L. Margrey, and W. C. Graves.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1005-1017, 3 tab, 20 ref. Contract No. P-74-80-04.

Descriptors: *Water pollution effects, *Cooling water, *Chlorination, *Thermal pollution, *Fish, *Invertebrates, Crabs, Temperature effects, Toxici-

ty, Fish eggs, Larvae, Powerplants, Opossum shrimp, Shrimp, Striped bass, Bass, Perch, White perch, Grass shrimp, Amphipods, Aquatic life, Chesapeake Bay, Residual chlorine.

The early developmental stages of fish species were generally more sensitive to chlorine under test conditions of varying temperature and chlorination than invertebrates, except for opossum shrimp. Blue crabs tested at both 15 and 25 C were found to be the most tolerant species; no significant mortality occurred under any test conditions. Striped bass prolarvae tested at 22.5 C were the most sensitive species; about 99% mortality occurred during the study. Species were more sensitive to simulated powerplant chlorination conditions at the higher acclimation temperature. Elevated temperature was the main factor causing mortality of striped bass eggs at both acclimation temperatures and of prolarvae at the high acclimation temperature. Total residual chlorine (TRC) was the dominant factor contributing to mortality of striped bass prolarvae (low acclimation temperature), striped bass larvae (low and high acclimation temperature), and white perch larvae. For the invertebrates tested, TRC was the dominant factor causing mortality of grass shrimp (low acclimation temperature), opossum shrimp (low acclimation temperature), and amphipods (low and high acclimation temperatures). The dominant factor causing mortality of opossum shrimp at the high acclimation temperature was elevated temperature. Grass shrimp mortality at the high acclimation temperature was attributed to TRC, elevated temperature, and exposure time. (Author's abstract)
W88-03520

EFFECTS OF CHLORINE RESIDUALS ON THE BLUE ROCKFISH (SEBASTES MYSTINUS),
SCS Engineers, Inc., Long Beach, CA.
S. W. Wiley.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1019-1027, 5 fig, 1 tab, 13 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cooling water, *Fish, Toxicity, Rockfish, Blue rockfish, Gills, Residual chlorine, Fish physiology.

Juvenile blue rockfish were exposed to sublethal and lethal chlorine concentrations during a 20-min pulse at 18.4 C. No mortalities occurred in the control or at total residual chlorine concentrations of 0.11 and 0.29 mg/L. Treatments of 0.5, 0.6, and 0.7 mg/L total residual chlorine induced 6, 11, and 12 deaths, respectively. Examination of the cerebellum tissue showed no variation among treatments. No alterations of liver tissue were observed at levels lower than about 0.6-0.7 mg/L total residual chlorine. At that level necrosis was noticeable. No gill damage resulted from the control and 0.1 mg/L total residual chlorine treatments. At the 0.3 mg/L treatment gill edema and hyperplasia was present. Gill damage was progressively worse in the exposures of 0.5, 0.6, and 0.7 mg/L total residual chlorine. Necrotic areas were visible. Interlamellar spaces were virtually nonexistent at the highest exposure. Fish responded to lethal concentrations by displaying erratic opercular movements and loss of equilibrium, presumed to be a result of asphyxiation. (Cassar-PTT)
W88-03521

BIOCONCENTRATION OF BROMOFORM BY AMERICAN OYSTERS, CRASSOSTREA VIRGINICA (G.), EXPOSED TO CHLORINATED AND DECHLORINATED SEAWATER, WITH NOTES ON SURVIVAL AND FEEDING,
Research Planning Inst., Inc., Meggett, SC.
G. I. Scott, D. P. Middaugh, and S. Klingensmith.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1029-1037, 3 fig, 1 tab, 16 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Chlorination, *Bromoform, *Bioaccumulation, Oysters, Invertebrates, Accumulation, Trihalomethanes, Organic compounds, Shellfish, Sodium thiosulfate, Food habits, Behavior.

Oysters exposed to three chlorination and/or dechlorination treatments and a seawater control were studied to determine their potential for bromoform uptake. The experiments were as follows: chlorine with a nominal concentration of 1.0 mg/L, (2) chlorinated seawater dechlorinated with a nominal concentration of 2.0 mg/L of sodium thiosulfate, and (3) seawater with sodium thiosulfate at nominal concentration of 2.0 mg/L. All treatments ran for 32 days, followed by 16 days of depuration. Percentage survival was highest (nearly 100%) in the chlorinated-dechlorinated treatment. Survivals in the other treatments were similar to each other, on the order of 80-95%. Feeding rates were lowest in the chlorinated treatment, about 20% during exposure. However, by the end of the depuration period about 90% had resumed feeding. Oysters did not accumulate substantial quantities of bromoform. Except for oysters in chlorinated seawater and sacrificed at 4 days exposure, bromoform bioaccumulation (131.6 ng bromoform/g wet weight) was similar in chlorinated and chlorinated/dechlorinated water. The maximum tissue-to-seawater bioconcentration ratio in chlorinated seawater was 5:1 on the fourth day of exposure; for chlorinated-dechlorinated water, 3:1. No bromoform was detected in oyster tissue 4 days after exposures had ended. (Cassar-PTT)
W88-03522

POWER PLANT CHLORINATION: IMMEDIATE AND PERSISTENT EFFECTS OF SUBLETHAL CONCENTRATIONS ON AN ESTUARINE CRUSTACEAN,
Miami Univ., Oxford, OH. Dept. of Zoology.
G. V. Poje, S. A. Riordan, and J. O'Connor.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1039-1051, 4 fig, 3 tab, 28 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cooling water, *Invertebrates, Gammarus tigrinus, Amphipods, Toxicity, Growth rates, Lethal limit, Sublethal effects, Estuarine environment, Powerplants, Residual chlorine.

The lethal and sublethal responses of Gammarus tigrinus, a crustacean, to chlorinated water were studied in the laboratory. Tolerance to chlorine decreased with increased exposure duration. At a 10-min exposure adults were more sensitive to chlorination (LC50 of 1.17 mg/L total residual chlorine (TRC)) than newly released young (LC50 of about 3 mg/L TRC). The response of newly released young gammarids to a sublethal exposure of 0.5 mg/L TRC was as follows: (1) increasing exposure duration to 30 min resulted in an increased total adenylate pool: only after 100 min exposure were the total adenylates reduced, (2) respiratory rates increased during the second hour of exposure and returned to normal after exposure. At a 10-min exposure to chlorine (0.05 to 3.0 mg/L) motility inhibition increased to 80% at the highest concentration. Mean duration of amplexus dropped below 50% of the observation period only after the pairs of amphipods had been immersed in chlorine concentrations of $>$ or $=$ 4.4 mg/L. Newly released gammarids exposed to a single 10-min 0.5 mg/L chlorine dose increased in weight by 25 times compared with an 80-fold increase in weight for control animals. No chlorine-stressed amphipods showed sexual maturity. Adult gammarids exposed to a single 10-min 0.5 mg/L dose of chlorine showed reduced growth by the second moulting cycle. (Cassar-PTT)
W88-03523

EFFECT OF CHLORINATION ON ENTRAINED PLANKTON AT SEVERAL UNITED KINGDOM COASTAL POWER STATIONS,
Central Electricity Generating Board, Fawley (England).
J. Coughlan, and M. H. Davis.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1053-1063, 5 fig, 2 tab, 8 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cooling water, *Zooplankton, *Phytoplankton, Powerplants, Estuaries, Sea water, Aquatic life, Productivity.

The effect of chlorine entrained in once-through powerplant cooling water was studied at five sites in estuaries and at open-coast sites in Great Britain. Zooplankton and phytoplankton populations tended to decrease with increasing chlorine concentrations. However, proportional species compositions and percent of mortality varied considerably among the sites for similar chlorine concentrations. The most probable explanation for the differences (mainly between estuarine and open-coast sites) is the presence of ammonia in the estuarine sites from agricultural runoff and municipal-industrial sources. Under these conditions the more toxic monochloramine is formed. (Cassar-PTT)
W88-03524

GROWTH OF DISINFECTION-RESISTANT BACTERIA AND SIMULATION OF NATURAL AQUATIC ENVIRONMENTS IN THE CHEMOSTAT,
Stanford Univ., CA.
J. D. Berg, A. Matin, and P. V. Roberts.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1137-1147, 3 fig, 2 tab, 26 ref.

Descriptors: *Water treatment, *Disinfection, *Bacteria, *Chlorination, *Chlorine dioxide, Coliforms, Growth rate, Chemostat, Bioindicators, Culture media, Indicators.

A chemostat was used to grow E. coli to simulate the populations found in natural aquatic environments, growth rates of which are often limited by low levels of organic substrate. This methodology proved more suitable for laboratory evaluation of disinfectants than conventional batch culture techniques. Through proper manipulation of the growth environment, E. coli can be altered to develop phenotypes that are one to three orders of magnitude more resistant to inactivation by chlorine dioxide than are organisms grown in batch cultures. The conditions in the chemostat include lower temperatures (15 C) and slower growth rates than are customarily used. The reason for chlorine dioxide's lethal action on bacteria is not loss of protein and other macromolecules, nor are all the cells protected by the presence of oxidant-consuming enzymes. The most important factor in chlorine dioxide resistance is the integrity of the outer membrane as determined by bound calcium and magnesium. Starved bacteria grown at 15 C and bacteria grown at 37 C at a fast rate (D=0.40/hr) were several orders of magnitude more sensitive to chlorine dioxide after EDTA treatment than bacteria grown at 15 C at a slow rate (D=0.60/hr). (Cassar-PTT)
W88-03532

CORRELATION OF WATER QUALITY PARAMETERS WITH MUTAGENICITY OF DRINKING WATER EXTRACTS,
Health and Welfare Canada, Ottawa (Ontario).
E. R. Nestmann, R. Otson, G. L. LeBel, D. T. Williams, and E. G. Lee.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1151-1164, 1 fig, 5 tab, 9 ref.

Descriptors: *Pollutant identification, *Chlorination, *Fate of pollutants, *Water treatment, *Mutagens, Organic compounds, Chlorinated hydrocarbons, Seasonal variation, Correlation analysis, Water analysis, Canada, Drinking water, Chlorination, Water pollution sources.

Mutagenicity of water samples collected from 30 Canadian treatment plants during summer and winter is reported and analyzed. Three plants had nonmutagenic samples in summer but were positive in winter. Five plants showed nonmutagenicity for winter samples, whereas summer samples were positive. Therefore, sampling in both seasons

was necessary to detect mutagenic activity in all 30 treatment plants. Both wet and dry extracts were required to detect mutagenicity of the active samples. Fifty-two out of 60 samples showed mutagenic activity. Testing with TA100 and TA98 agreed fairly well in summer samples, except in 5 cases. Mutagenicity maxima showed correlation within seasons. Correlations of mutagenicity with different treatment methods were not high (r=0.31-0.77); correlation with water quality parameters was even lower. Of the volatile organics determined in the samples, chloroform and bromodichloromethane were found most often. Mutagenicity did not correlate highly with total dissolved organic carbon. Individual organic compounds which showed the highest correlations with mutagenicity were present in the raw water and became more prevalent after treatment--benzene, ethyl benzene, toluene, and the xylenes. Compounds which probably were derived from the treatment processes were 1,2-dichloroethane, 1,2-dichloroethylene, dichloromethane, chloroform, and tetrachloroethylene. (Cassar-PTT)
W88-03533

CARCINOGENICITY OF CHLORINATION BY-PRODUCTS: TRIHALOMETHANES,
Health Effects Research Lab., Cincinnati, OH.
M. A. Pereira.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1165-1176, 3 fig, 4 tab, 30 ref.

Descriptors: *Water pollution effects, *Carcinogens, *Organic compounds, Trihalomethanes, Chlorinated hydrocarbons, Mutagens, Chloroform, Bromoform, Public health.

The mechanisms of carcinogenesis for the trihalomethanes (THMs) is reviewed. Evidence does not indicate anything but the weakest, if any, tumor-initiating activity for THMs. Chloroform, in all tests other than the low level of DNA binding, does not indicate any tumor-initiating activity. The only indicator that some other THMs are tumor initiators was their marginal mutagenic activity in the Ames Salmonella assay. However, the THMs appear to promote tumor formation as indicated by induction of regenerative hyperplasia, induction of molecular markers such as ornithine decarboxylase (ODC) and apparent weak promoting activity of chloroform in the rat liver foci bioassay. The dose-response relationship of the tumor-promoting activity of chloroform may have a threshold, as shown by the ODC induction and regenerative hyperplasia. Evidence leads to the hypothesis that the extrapolation model used to estimate the low-dose carcinogenic response for chloroform should differ from the model used for genotoxic carcinogens. (Cassar-PTT)
W88-03534

ALTERATION OF TRANSPLACENTAL CARCINOGENESIS BY CHLORINATED PHENOLS,
Idaho Univ., Moscow.
J. H. Exon, and L. D. Koller.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1177-1188, 9 tab, 14 ref.

Descriptors: *Water pollution effects, *Chlorophenols, *Carcinogens, Pentachlorophenol, Toxicity, Chlorinated phenols, Growth rate, Reproduction, Rats.

Rats were exposed to 5, 50 and 500 ppm of 2-chlorophenol or pentachlorophenol in drinking water. Litter sizes of rats exposed to the highest levels of each chemical were smaller compared with controls. This effect was most evident in groups exposed to the chemicals prenatally. A dose-response effect on litter size was observed in the 2-chlorophenol-treated animals. No consistent effects were seen in survival to weaning in rats receiving either chemical. Weaning weight of rats given 2-chlorophenol was generally decreased. Body weights of female rats treated with 2-chlorophenol were also decreased after 7 months of exposure, whereas 2-chlorophenol-exposed male rats had generally increased body weight. This effect was also seen with pentachlorophenol-dosed rats. Tumor incidence and tumor latency were significantly increased in most groups of rats that received 2-chlorophenol and ethylnitrosourea precursors, compared with the positive ethylnitrosourea controls. In nontumor-bearing rats hematologic parameters were not changed by either chlorophenolic compound, ethylnitrosourea, or a combination of 2-chlorophenol or pentachlorophenol with ethylnitrosourea. Data on tumor incidence is reported here in the fifteenth month of a planned 24-month study. (Cassar-PTT)
W88-03535

SAFETY OF ORAL CHLORIDE DIOXIDE, CHLORITE, AND CHLORATE INGESTION IN MAN,
Ohio State Univ., Columbus. Dept. of Pharmacology.
J. R. Lubbers, J. R. Bianchine, and R. J. Bull.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1335-1341, 20 ref.

Descriptors: *Water pollution effects, *Chlorination, *Disinfection, Human pathology, Chlorine dioxide, Chlorites, Chlorates, Toxicity.

The effects of oral ingestion of chlorine dioxide, chlorite, and chlorate on humans (healthy adult males) was conducted in three phases: I--increasing doses for 6 sequences of 3 days each, II--chronic ingestion of 500 ml of 5 mg/L disinfectant daily for 12 weeks, and III--chronic ingestion of sodium chlorite under the same conditions as phase II by individuals deficient in glucose-6-phosphate dehydrogenase. No obvious undesirable clinical sequella were noted by any participants or by the observing medical team. In some cases statistically significant trends in biochemical of physiological parameters were noted. These were of small magnitude when compared with normal variations. Although the safety of these compounds has been demonstrated under the circumstances defined by the study, the conclusions cannot be extrapolated to the general population. The small population (3 persons) in the phase III study does not allow conclusive results to be stated. (Cassar-PTT)
W88-03546

RELATIONSHIPS OF CANCER INCIDENCE RATES IN IOWA MUNICIPALITIES TO CHLORINATION STATUS OF DRINKING WATER,
Iowa Univ., Iowa City. Coll. of Medicine.
P. Isacson, J. A. Bean, and C. Lynch.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1353-1364, 6 tab, 10 ref.

Descriptors: *Water pollution effects, *Chlorination, *Chlorinated hydrocarbons, Epidemiology, Cancer, Trihalomethanes, Organic compounds, Water treatment, Public health, Iowa, Drinking water, Water supply, Surface water, Groundwater, Chloroform, Bromine compounds, Risks.

Data on cancer incidence in Iowa towns supplied with surface water or groundwater, chlorinated and unchlorinated, showed relationships between chlorination and incidence rates of bladder cancer among males, lung cancer among females, and rectal cancer among both males and females. Incidence rates of lung and rectal cancers among females were higher for surface than groundwater supplies. In the study area chlorination of surface water yielded primarily chlorinated trihalomethanes (THMs), whereas in chlorinated groundwater brominated THMs were more prevalent. Rates for bladder cancer among males did not differ between surface and groundwater sources. Bladder cancer rates appeared to be more closely associated with brominated THMs. Rates for cancer of the breast, stomach, and colon were not significantly different between surface water and groundwater sources. Male residents of towns supplied with nonchlorinated water had higher rates of rectal cancer than residents using chlorinated water. As the mean level of chloroform increased, the incidence rates for bladder cancer among males and for rectal cancer among males and females increased. As dibromochloromethane levels increased, bladder cancer among males increased more sharply than with chloroform and dichlorobromomethane. (Cassar-PTT)
W88-03548

MATCHED PAIR CASE CONTROL STUDY OF DRINKING WATER CHLORINATION AND CANCER MORTALITY,
Wisconsin Univ.-Madison. Dept. of Preventive Medicine.
T. B. Young, and M. S. Kanarek.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1365-1380, 6 tab, 20 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cancer, Chlorinated hydrocarbons, Epidemiology, Trihalomethanes, Organic compounds, Water treatment, Public health, Drinking water, Water supply, Mortality, Risks.

A matched pair analysis of the death certificates of 8029 pairs of females dying of gastrointestinal, urinary tract, brain, lung, and breast cancer in Wisconsin between 1972 and 1977 shows that use of chlorinated water for about 20 years increases the risks for colon cancer. The overall risk is 1.41 for chlorinated vs. nonchlorinated water. Chlorinated unpurified water and chlorinated water with organics cause higher risk; chlorinated shallow sources, slightly lower risk. Organic contamination appears to increase risk by a factor of 2, and water purification appears to reduce risk by a factor of about 3. These findings indicate that contaminants other than trihalomethanes may be present in chlorinated water and may affect cancer mortality rates. (Cassar-PTT)
W88-03549

EPIDEMIOLOGIC STUDIES OF CHLORINATION BY-PRODUCTS IN DRINKING WATER: AN OVERVIEW,
National Cancer Inst., Bethesda, MD. Environmental Epidemiology Branch.
K. P. Cantor.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1381-1398, 4 fig, 5 tab, 32 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Chlorination, *Cancer, Chlorinated hydrocarbons, Epidemiology, Trihalomethanes, Organic compounds, Water treatment, Public health, Drinking water, Water supply, Surface water, Groundwater, Chloroform, Bromine compounds, Bromoform, Risks.

Information gathered in a case-control interview study of bladder cancer has been correlated with previous epidemiological studies of water quality and cancer mortality. The data in the present study confirms the previous studies which suggest that the presence and amounts of halogenated compounds in the water supply are closely related to the type of water source and its treatment. Most chlorinated surface sources have much higher levels of chloroform and other compounds than ground sources, except for brominated trihalomethanes, which are found at higher levels in groundwater. Data in the case-control study indicate that, in previous studies, the water source may have been misclassified for 20-40% of the study subjects. Of 197 chlorinated surface water sources from protected watersheds, 99% had detectable chloroform, 94% had detectable bromodichloromethane, 61% had detectable dibromochloromethane, and 14% had detectable bromoform. Of 551 chlorinated groundwater sources, 84% had detectable chloroform, 65% had detectable bromodichloromethane, 65% had detectable dibromochloromethane, and 57% had detectable bromoform. Geometric mean values (in micrograms/L) for chlorinated surface water were 50-60 for chloro-

form, 0.08-0.2 for bromoform; for chlorinated groundwater, 0.8 for chloroform, 0.4 for bromoform. Nonchlorinated groundwater contained 0.2 micrograms/L chloroform and 0.08 micrograms/L bromoform (geometric mean values). (Cassar-PTT)
W88-03550

HEALTH RISKS OF DRINKING WATER DISINFECTANTS AND DISINFECTION BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
R. J. Bull.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1401-1415, 4 tab, 45 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Disinfection, *Chlorination, Water treatment, Risks, Public health, Drinking water, Trihalomethanes, Chlorinated hydrocarbons, Toxicity, Chlorine dioxide, Chlorites, Chloramines, Mutagens, Bromine compounds, Chloroform, Organic compounds.

The status of the health risks of drinking water disinfection methods is reviewed. No definitive answer to the question of relative risks can be provided. Although it is apparent that chlorine is associated with health problems, the dimensions of risk and the relative hazards of alternative disinfection methods cannot be clearly determined. Therefore, no basis for suggesting that alternative disinfection methods are safer toxicologically than chlorine. Chlorine dioxide appears to be more hazardous than other disinfection methods, particularly among populations sensitive to hemolytic anemia, endocrine disorders, and in women of reproductive age. Chlorine intermediate products need further investigation, as do chloramines, which are mutagenic. Disinfectants reacting with organic matter in raw water produce byproducts with biological activity of concern, for example, trihalomethanes. Other reaction products remain to be characterized chemically and toxicologically. The fundamental processes that occur as a result of reaction of disinfectants with organic matter in the raw water need further understanding. (Cassar-PTT)
W88-03551

STUDIES ON THE WATER QUALITY HAZARD OF CHLORINE IN DOMESTIC WASTEWATER TREATMENT PLANT EFFLUENTS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
B. W. Newbry, G. F. Lee, R. A. Jones, and T. J. Heinemann.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1423-1436, 6 fig, 2 tab, 22 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Fish, *Chlorination, *Wastewater treatment, Effluents, Fathead minnows, Disinfection, Toxicity, Aquatic habitats, Cache La Poudre River, Big Thompson River, Arkansas River, Fountain Creek, Colorado, Benefits, Recreation, Fishing, Sublethal effects.

The effects of chlorinated wastewater effluents on caged fish (fathead minnows) was studied in four Colorado Front Range rivers. The 96-hour LC50 varied from 0.042 to 0.093 mg/L chlorine. Chlorine isoconcentration lines were mapped for each river showing the zones of greater than 50% mortality, 50% mortality, and less than 50% mortality. Estimated length of river reach in which chronic toxicity could be expected were as follows: Fort Collins No. 1 plant, 6.1 km; Fort Collins No. 2 plant, 3.0 km; Loveland, 3.2 km; Pueblo, 14.7 km; and Colorado Springs, 41.5 km. A relatively small area near each discharge has chlorine concentrations which could be acutely lethal to fish if they stayed in the area for a few days. However, most fish would likely avoid this area. Removing chlorine from the effluents is not likely to improve recreational fishing in these particular rivers for several reasons (1) a sizeable sport fish population already exists in the zone of chronic toxicity; numbers and types of fish in river reaches above and below the existing discharges are about the same, (2) toxicants other than chlorine may be present, (3) at higher flows than the low-flow, worst case conditions usually used to establish toxicity zones, the chronic toxicity would be reduced, (4) at least one river has no public access to fishing. (Cassar-PTT)
W88-03553

RISK FROM RESIDUAL CHLORINE IN COOLING WATERS USED FOR AQUACULTURAL PURPOSES,
Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica.
M. G. Saroglia, and G. Scarano.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1437-1445, 3 fig, 1 tab, 12 ref.

Descriptors: *Water pollution effects, *Fish, *Chlorination, *Cooling water, *Aquaculture, Eels, Sea bass, Bass, Sea bream, Bream, Mullet, Seawater, Bioassay, Residual chlorine, Toxicity, Mortality.

Bioassays were run on four Mediterranean area commercial fish species (mostly fingerling size) to determine the effects of chlorinated seawater cooling waters used in aquaculture. The 97-hour LC50s expressed in micrograms/L total residual oxidant were as follows: mullet (Mugil cephalus), 127.9; sea bass (Dicentrarchus labrax), 60.0-94.6; sea bream, (Sparus aurata), 95.1; and European eel (Anguilla anguilla), 106.6-115.5. The 168-hr LC50's were very similar. In fresh water the LC50s for eels was 150.3 (97-hr) and 149.0 (168 hr). Increasing pH decreased the toxicity of the residual oxidant. The ratio of 168-hr safe concentration to 96-hr LC50 for all species was 0.6-0.8. Limited studies at early growth stages showed that elver and bootlace eel and postlarval and fingerling sea bass were more sensitive to the residual oxidant. (Cassar-PTT)
W88-03554

ISSUES IN HUMAN RISK ASSESSMENT,
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 6B.
W88-03556

COST-BENEFIT APPROACH TO DRINKING WATER AND CANCER,
California Inst. of Tech., Pasadena.
For primary bibliographic entry see Field 6B.
W88-03557

CHLORINATED DRINKING WATER AND CANCER: THE STRENGTH OF THE EPIDEMIOLOGIC EVIDENCE,
Science Research Systems, Inc., Ruston, LA.
K. S. Crump.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1481-1491, 4 tab, 20 ref.

Descriptors: *Water pollution effects, *Chlorination, *Cancer, Epidemiology, Drinking water, Iowa, Maryland.

Although a causal relationship between chlorinated drinking water has not been established, the evidence suggests, to a considerable extent and cancer, such a relationship for rectal cancer and, to a lesser extent, for bladder and colon cancer. If the increased risk ratios for rectal cancer found in the completed case-control studies are, in fact, caused by chlorinated drinking water, then the findings in these studies are consistent with the prediction that 7500 new cases of rectal cancer might be caused each year in the United States by chlorinated drinking water. (Author's abstract)
W88-03558

WATERBORNE OUTBREAKS IN SWEDEN - CAUSES AND ETIOLOGY,
National Bacteriological Lab., Stockholm (Sweden).
Y. Andersson, and T. A. Stenstrom.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 185-190, 1986. 1 fig, 3 tab, 10 ref.

Descriptors: *Water pollution effects, *Public health, *Epidemiology, *Human diseases, Epidemics, Diseases, Pathogenic bacteria, Pathogens, Bacteria, Wastewater pollution.

During 1975-1984 32 waterborne outbreaks occurred in Sweden, affecting nearly 12,000 people. These ranged from single family outbreaks to community outbreaks affecting up to 3000 people. Microbial agents have been isolated in 40% of the outbreaks; the rest are of unknown etiology. Epidemiological investigations have shown that only a fraction of the total number of cases are initially reported. The real number, as judged by epidemiological follow-up investigations, was in many cases ten-fold higher. In almost all cases the cause of the outbreaks were technical deficiencies like backsiphonage of wastewater along drainage pipes, broken sewage or sudden pollution of raw water intakes coinciding with malfunction of chlorination. (Authors' abstract)
W88-03580

EPIDEMIOLOGICAL MODEL OF THE POTENTIAL HEALTH RISK ASSOCIATED WITH VARIOUS PATHOGENS IN WASTEWATER IRRIGATION,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
H. I. Shuval, P. Yekutiel, and B. Fattal.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 191-198, 1986. 3 fig, 5 ref.

Descriptors: *Impaired water use, *Water pollution effects, *Waste disposal, *Public health, *Epidemiology, Wastewater irrigation, Wastewater farming, Land disposal, Bacteria, Viruses, Parasites.

This study reviewed and evaluated all available documented epidemiological evidence to determine the significant, quantifiable health effects on population groups directly or indirectly exposed to wastewater irrigation: through occupation, by residing in contiguous communities, or by consuming the sewage irrigated crops. An epidemiological model predicting the degree of risk associated with the various groups of pathogens was developed. The risk of pathogen transmission by irrigation with raw wastewater for most developing countries is according to the following descending order: high helminths (Ascaris, Trichuris, Ankalostoma and Taenia), lower- bacteria (Typhoid and Cholera), and lowest- viruses. Based on both theoretical and empirical findings, there appears to be a basis for relaxing the conventional effluent quality standards for unrestricted crop irrigation. A guideline of no helminths in 1 liter and a log mean of 1000 coliforms per 100 ml is proposed. (Authors' abstract)
W88-03581

PROSPECTIVE EPIDEMIOLOGICAL STUDY OF HEALTH RISKS ASSOCIATED WITH WASTEWATER UTILIZATION IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal, P. Yekutiel, Y. Wax, and H. I. Shuval.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 199-209, 1986. 1 fig, 9 tab, 5 ref.

Descriptors: *Water pollution effects, *Impaired water use, *Wastewater disposal, *Epidemiology, *Wastewater irrigation, Wastewater farming, Bacteria, Viruses, Public health, Human diseases.

A prospective epidemiological morbidity and serology study was carried out in Israel in 1980-82 on the association between enteric disease incidence and wastewater utilization in 29 kibbutzim (collective agricultural communities) with a population of 15,605. Morbidity data indicated that no significant excess of enteric disease episode rates

was found in any age group, including the 0-5 year old age group, or in any occupational group, in kibbutzim exposed to wastewater aerosols versus kibbutzim using wastewater, but not exposed to aerosols, or kibbutzim not exposed to wastewater in any form. Viral antibodies in blood sera of a subsample of the population generally confirmed the findings of the morbidity study. No excess in antibody level for 8 enteroviruses tested was found in the population exposed to the aerosolized wastewater versus the control kibbutzim. However, a consistent and significant excess of prevalence for ECHO 4 virus antibodies was found in the 0-5 year old age group in kibbutzim exposed to aerosolized wastewater from nearby towns as compared with all other populations ($p<0.001$). No excess of morbidity was detected, however, in this group. A significant excess in the percentage of sera positives was found for Legionella pneumophila (serogroup 1-8) among all water contact workers versus nonwater contact control group workers (4.5% vs 1.5%). However, no differences were found between wastewater-contact and clean-water contact workers. In field studies, aerosolized enteric bacteria and viruses of wastewater origin were detected in air samples as far as 730m downwind of wastewater sprinkler irrigated plots. (Authors' abstract)
W88-03582

ASSESSING RISK OF SOLID WASTE COMPOST,
Wisconsin Univ.-Stevens Point.
J. M. Dyer, and A. S. Razvi.
BioCycle BCYCDK, Vol. 24, No. 3, p 31-36, 54, March 1987. 2 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Waste treatment, *Solid waste, *Composting, *Groundwater pollution, *Heavy metals, *Path of pollutants, *Water pollution effects, *Leaching, Water pollution, Domestic wastes, Bioaccumulation, Plant physiology, nutrients, Soil amendments, Soil properties.

A worst case scenario was examined by applying compost treatments in excess of recommended rates for the soil type and precipitation rate chosen. Resultant leaching losses and groundwater contamination potential exceeded those expected under field conditions where sound waste management techniques may be practiced. The 25% compost/soil mixture used closely approached the actual lifetime waste application rate that might be used on a soil with low CEC. Because the minimum three feet depth to groundwater requirement was not maintained in this greenhouse study, levels of nitrate and lead in the leachate exceeded the EPA drinking water standards in the initial leaching intervals. Groundwater contamination by heavy metals from the application of compost to sandy soils with a suitable depth of subsoil would be minimal. Nutrients in soluble form that were not taken up by the plants, were leached. Nitrogen and phosphorus were fund at normal levels in the plant tissues. Luxury uptake was observed for potassium at the highest compost treatments. Copper and zinc were at normal tissue concentrations in the 25% compost/soil treatment. Lead and nickel were below detection limits for all treatments. Cadmium was detected in the bean fruit of the 100% compost treatment, but not in the other treatments. Refuse-derived compost can be used as a soil amendment and plant nutrient source without impacting the environment and food chain crops in excess of tolerable levels. (Main-PTT)
W88-03595

MICROBIAL IMPLICATIONS OF DIEL VARIATIONS IN WATER QUALITY PARAMETERS POSSIBLY ASSOCIATED WITH ACID DEPOSITION IN AN OLIGOTROPHIC RESERVOIR,
New England Research, Inc., Worcester, MA.
P. A. Erickson, and J. T. Reynolds.
Journal NEWWA JENWA6, Vol. 101, No. 1, p 32-61, March 1987. 10 fig, 3 tab, 33 ref.

Descriptors: *Sulfates, *Microbes, *Diel variations, *Acid rain, *Oligotrophic lakes, *Water pollution effects, *Lakes, *Hypolimnion, *Massachusetts, Water quality, Reservoirs, Environmental quality, Thermal stratification, Monitoring, Alkalinity, Ammonia, Carbon dioxide, Chemicals, Thermocline, Limnology.

Monthly monitoring of concentrations of sulfate and alkalinity in the surface water of a large oligotrophic reservoir in central Massachusetts in the period 1971-1979 suggest a progressive influence of acid deposition on chemical constituents of the water column. Diel monitoring of surface, thermocline, and hypolimnetic waters during summer stratification in the period 1972-1976 indicates that possible effects of acid deposition are most pronounced at depths below the photic zone. The observed diel variations in pH, alkalinity, carbon dioxide and ammonia over the five-year diel study period may be explained by assuming pH-induced effects on microbial populations involved in mineralization, nitrification and/or carbon dioxide fixation. Diel variations in water quality parameters possibly associated with acid deposition also suggest that relatively short-term monitoring studies of deep, hypolimnetic waters in oligotrophic systems may be a more sensitive and accurate a means of documenting the effects of acid deposition than the more commonly used long-term monitoring studies of surface waters. (Author's abstract)
W88-03615

REVIEW AND PERSPECTIVE ON THE USE OF MIXED-FUNCTION OXYGENASE ENZYMES IN BIOLOGICAL MONITORING,
Department of Fisheries and Oceans, St. John's (Newfoundland). Fisheries Research Branch.
For primary bibliographic entry see Field 5A.
W88-03648

SERUM TRANSAMINASES ACTIVITY AND HISTOPATHOLOGICAL CHANGES IN CLARIAS LAZERA CHRONICALLY EXPOSED TO NITRITE,
Alexandria Univ. (Egypt).
M. I. Michael, A. M. Hilmy, N. A. El-Domiaty, and K. Wershana.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 255-262, 1987. 6 fig, 23 ref.

Descriptors: *Water pollution effects, *Pollutants, *Nitrites, *Toxicity, Clarias lazera, Fish, Histopathological changes, Chronic toxicity, Serum transaminases.

Increase in serum transaminases (GOT and GPT) activity attributable to nitrite toxicity was observed in juvenile Clarias lazera after chronic exposure to nitrite. The application of SGOT and SGPT assays for monitoring the effect of nitrite exposure over a 6-month period has shown that changes in activities are correlated with histological effects in Clarias liver. Kidneys from fish exposed to nitrite were apparently not different histologically from that of control fish. Hypertrophy and hyperplasia were the most consistent lesions that occured in the gills. Lifting of lamellar epithelium and necrosis of some epitheal cells were also prominent. (Author's abstract)
W88-03650

TOXICITY IN TILAPIA ZILLI AND CLARIAS LAZERA (PISCES) INDUCED BY ZINC, SEASONALLY,
Alexandria Univ. (Egypt).
A. M. Hilmy, N. A. El-Domiaty, A. Y. Daabees, and H. A. A. Latife.
Comparative Biochemcial and Physiology (C) CBPCEE, Vol. 86, No. 2, p 263-265, 1987. 9 tab, 22 ref.

Descriptors: *Pollutants, *Water pollution effects, *Zinc, Pollution, *Toxicity, Fish, Clarias lazera, Tilapia zilli, Bioassay, Assay, Seasonal variation, Heavy metals.

Subadult teleosts, Tilapia zilli and Clarias lazera, were exposed in laboratory bioassays to lethal and sublethal concentrations of zinc, seasonally. It appears that Tilapia is more suseptible to Zn than Clarias and both species are more resistant to Zn toxicity at lower temperature (during winter). To determine the uptake and tissue distribution of Zn in the two species, gill, liver, and muscles were analysed at moderate temperature (during spring). After a 96hr exposure period, Zn was decreased in the following order: gill > liver > muscle. (Author's abstract)
W88-03651

CD-METALLOTHIONEIN AND METAL-ENZYMES INTERACTIONS IN THE GOLDFISH CARASSIUS AURATUS,
Bologna Univ. (Italy).
E. Carpene, P. Cortesi, S. Tacconi, O. Cattani, and G. Isani.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 267-272, 1987. 7 fig, 17 ref.

Descriptors: *Water pollution effects, *Cadmium, *Pollutants, *Toxicity, Enzymes, Metals, Heavy metals, Fish, Goldfish, Carassius auratus, Alkaline phosphatase, Fructose biphosphatase, Cadmium chloride, Metallothionein.

Goldfish injected with cadmium chloride synthesized metallothionein. Ten days after the first injection, cadmium reached a mazimum in the metallothionein peak obtained after gel filtration of liver cytosol. Pyruvate kinase activity again started to increase but did not reach the control level. Alkaline phosphatase and fructose biphosphatase did not show any noticeable inhibition. From the results here reported, a detoxifying role of metallothionein could be suggested. (Author's abstract)
W88-03652

CORRELATIVE STUDIES ON CHANGES IN LIPID COMPOSITION OF GILLS AND UPTAKE OF CHEMICALS OF WILLOW SHINER FISH (GNATHOPOGON CAERULESCENS) BY EXPOSURE TO DETERGENT,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
H. Nakanishi, T. Tsuda, S. Fukui, and T. Hirayama.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 339-341, 1987. 1 fig, 3 tab, 9 ref.

Descriptors: *Water pollution effects, *Pollutants, *Toxicity, *Detergents, Fish, Willow shiner fish, Gnathopogon caerulescens, Lipids, Gill extracts, Cholesterol, Bioassay.

One group of willow shiner (Gnathopogan caerulescens) was exposed to 0.1 mg/1 dodecylbenzenesulfonate (DBS) for analysis of lipid composition of gill extracts. Another group of fish was exposed to 0.0003 mg/1 2,4,6-trichlorophenyl-4'-nitrophenyl-ether (CNP) after regular intervals of preexposure to 0.1 mg/1 DBS for analysis of uptake of CNP. The whole body residues of CNP were characterized by a 60 percent drop in DBS preexposure for 14 and 21 days. The cholesteral/total phospholipid ratio increased to 0.22 and 0.28 after 14 and 21 days from the normal of 0.18. These biochemical results might be correlated with the changes observed by the uptake of CNP. (Author's abstract)
W88-03653

CHANGES OF THE LIVER UDP-GLUCURONOSYLTRANSFERASE ACTIVITY ON TROUT (SALMO GAIRDNERI RICH.) ACUTELY EXPOSED TO SELECTED AQUATIC TOXICANTS,
Helsinki Univ. (Finland). Dept. of Zoology.
M. Castren, and A. Oikari.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 357-360, 1987. 1 fig, 3 tab, 26 ref.

Descriptors: *Water pollution effects, *Pulp wastes, *Pollutants, *Trout, *Toxicity, Liver, Poisons, Salmo gairdneri, Hazardous materials, Rainbow trout, Effluents.

Rainbow trout were exposed for 4 or 8 days to various types of toxicants, each applied to the test

water at a high sublethal concentration. The activity of liver UDP-glucuronosyltransferase (UDP-GT) was assayed from the submitochondrial fraction using p-nitrophenol as an aglycone. Activity of UDP-GT was inhibited by 2,4,6-trichlorophenol, pentachlorophenal and dehydroabietic acid, all toxicants regularly found in effluents of the pulp and paper industry. The heavy metals cadmium and zinc, the polychlorinated biphenyl, Pyralene 3010, and chloroform did not affect UDP-GT activity. The slimicide N-methyl-dithiocarbamate signifcantly increased the enzyme activity. (Author's abstract)
W88-03654

COMPARATIVE STUDIES ON ADDITIVE EFFECTS OF SODIUM DODECYLBENZENSULFONATE AND SODIUM STEARATE ON UPTAKE OF CHEMICALS BY WILLOW SHINER (GNATHOPOGON CAERULESCENS),
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
H. Nakanishi, T. Tsuda, S. Fukui, and T. Hirayama.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 361-364, 1987. 3 fig, 3 tab, 9 ref.

Descriptors: *Water pollution effects, *Detergents, *Pollutants, *Toxicity, Pollution, Willow shiner, Gnathopogon, Sodium dodecylbenzensulfonate, Sodium stearate, Chemical wastes, Freshwater fish, Fish, Heavy metals.

Comparative studies between sodium dodecylbenzenesulfonate (DBS) and sodium stearate (SNa) were performed on the additive effects of the uptake of chemicals in a fresh water fish, the willow shiner (Gnathopogan caerulescens), by the use of a continuous flow water system. The chemicals selected were 2,4,6-trichlorophenyl ether (CNP) as a non-polar lipophilic substance and cadmium salt (Cd) as polar hydrophylic substance. DBS displayed no promotive and depressed effects on the uptake of Cd. SNa had no promotive and depressed effects on the uptake of CNP and Cd. (Author's abstract)
W88-03655

INFLUENCE OF WATER PH ON THE PERIVITELLINE FLUID OF PERCH (PERCA FLUVIATILIS) EGGS,
Buckingham Univ. Coll. (England). Dept. of Life Sciences.
K. L. Shephard.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 383-386, 1987. 3 fig, 16 ref.

Descriptors: Descriptors:*Pollutants, *Water pollution effects, *Acidity, *Hydrogen ion concentration, Perch, Fish, Perca, Perivitelline fluid, Eggs, Pollution, Water pollution.

The diameter, trans-chorion potential difference and perivitelline-fluid pH of the eggs of perch (Perca fluviatilis) have been measured in a range of water pH (8-4.5). The water used was relatively nutrient rich. Eggs transferred from pH 8 to pH 4.5 shrink; probably as a result of loss of water from perivitelline fluid. Trans-chorion potential differences are close to zero over the range of pH. Mean perivitelline-fluid pH is higher than external water pH at pH 6.7 and above. Below pH 6.7, mean perivitelline-fluid pH is approximately the same as external water pH. The results suggest a non-Donnan distribution of hydrogen ions. The results are compared with data on salmonid eggs in nutrient-poor waters. (Author's abstract)
W88-03656

DNA REPAIR SYNTHESIS IN CULTURED FISH AND HUMAN CELLS EXPOSED TO FISH S9-ACTIVATED AROMATIC HYDROCARBONS,
British Columbia Cancer Research Center, Vancouver. Environmental Carcinogenesis Unit.
D. G. Walton, A. B. Acton, and H. F. Stich.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 399-404, 1987. 7 fig, 31 ref.

Descriptors: *Aromatic hydrocarbons, *Toxicity, *Oil wastes, *Carcinogens, *Pollutants, *Hydrocarbons, *Water pollution effects, Fish, Trout, Rainbow trout, Human cells, DNA, Aflatoxin, DNA repair synthesis, Human fibroblast, Gonads, Liver.

Unscheduled DNA repair synthesis was measured autoradiographically in cultured rainbow trout gonad (RTG) and human fibroblast (HF) cells following exposure to aflatoxin B1 (AFB1), 3,4-benzopyrene (BP), 1,2,5,6-dibenzanthracene (DBA), 1,2-benzanthracene (BA) and pyrene (PY) activated with S9 prepared from rainbow trout liver. S9 from rainbow trout injected with Arochlor 1254 or an oil extract was compared with S9 from Fischer rats injected with Arochlor 1254 for the ability to activate AFB1 and cause DNA repair in RTG and HF cells. All three types of S9 activated AFB1, but the measured DNA repair response was greater in the HF cells. A significant grain count response was found following exposure of HF cells to fish S9-activated BP. Using assay conditions which enhance fish cell grain counts, a significant level of DNA repair was also found in RTG cells exposed to fish S9-activated BP. Marginal but statistically significant amounts of DNA repair were elicited in HF and RTG cells exposed to rainbow trout S9-activated BA and DBA, but no response was detected following PY exposure. Fish S9 was able to activate a series of polycyclic aromatic hydrocarbons (PAH) and cause DNA repair synthesis in both fish and mammalian cells. The magnitude of the repair response roughly parallels the carcinogenic potential of the PAHs. These results elicit trans species and phyla comparisons which help to validate fish as models for aquatic carcinogenesis research, and also demonstrate PAH DNA-damaging effects on fish DNA, adding further credence for studying the effects of these chemicals on aquatic organisms. (Author's abstract)
W88-03657

STUDIES ON THE INFLUENCE OF NITRITE ON METHEMOGLOBIN FORMATION IN AMOZONIAN FISHES,
California Univ., San Diego, La Jolla. Lab. for Comparative Biochemistry.
G. R. Bartlett, A. R. Schwantes, and A. L. Val.
Comparative Biochemical and Physiology (C) CBPCEE, Vol. 86, No. 2, p 449-456, 1987. 6 fig, 5 tab, 25 ref.

Descriptors: *Pollutants, *Toxicity, *Water pollution effects, *Nitrites, Fish, Amazon, Brazil, Brycon, Methemoglobin, Water pollution, Hemoglobin, Hemolystates.

Twenty one species of fishes, collected form the Rio Solimoes and a tributary lake in the Amazon Basin near Manaus, showed a wide range of methemoglobin formation 1hr after a dose of 30 mg/kg of sodium nitrite i.p. Methemoglobin formation in two experimental fishes, Brycon cf. melanopterum and Semaprochilodus insignis, maintained in tanks in our INPA laboratory, was studied in detail. Both fishes survived a dose of 10 mg/kg of nitrite i.p. but usually died within 3hr of a dose of 30 mg/kg with levels of blood methemoglobin in excess of 80 percent. Methemeglobin produced in vitro by addition of nitrite to fresh blood was gradually reduced back to hemoglobin over a period of several hours at room temperature. Hemoglobin in hemolysates was auto-oxidized to methemoglobin at pH 6.1 and below but not at 6.9 and above. (Author's abstract)
W88-03658

EFFECTS OF SALINITY AND VARYING BORON CONCENTRATIONS ON BORON UPTAKE AND GROWTH OF WHEAT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
F. T. Bingham, J. E. Strong, J. D. Rhoades, and R. Keren.
Plant and Soil PLSOA2, Vol. 97, No. 3, p 345-351, March 1987. 4 tab, 12 ref.

Descriptors: *Soil management, *Water pollution effects, *Path of pollutants, *Soil water, *Irrigation, *Boron, Wheat, Osmotic potential, Sandculture experiments, Triticum, Toxicity, Salinity, Chemical properties.

Two sandculture experiments were conducted with wheat to determine the effects of osmotic potential and fluctuating boron concentrations on B availability (toxicity), shoot growt and leaf concentrations of B wheat. The first experiment consisted of growing wheat to the spike emergence stage in sandcultures irrigated with a complete nutrient solution containing 1.0, 7.5, and 15.0 mg B1(-1) and having potential values of -0.02, -0.07, -0.12, and 0.17 MPa produced by CaCl2-NaCl additions. Statistically, shoot weight was independently influenced by the B treatments but not by its interaction. Only the B treatment had a significant effect on leaf boron concentrations; the B x potential interaction was nonsignificant with respect to leaf B concentrations. The second experiment was designed to determine if growth and B uptake of wheat responds to the time integrated mean (TIM) concentration of B. This experiment consisted of four fixed-B concentrations and four fluctuating-B concentrations designed to produce two TIM concentrations approached low to high and vice versa. With respect to shoot weight, there was no statistical difference among treatments having the same TIM concentration during the 10 week experiment. However, shoot B concentrations differed greatly; they were higher when the B concentration was progressively increased over the 10 week period. Leaf B concentrations (Y leaf at flowering), while not as the shoot B concentrations, were also higher under the treatment of increasing B concentration, indicating B uptake rates are higher for mature plants than for seedlings. (Author's abstract)
W88-03661

EFFECTS OF COLORANTS IN THE AQUATIC ENVIRONMENT,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
D. Brown.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 139-147, April 1987. 2 fig, 1 tab, 21 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Pollutants, *Dyes, *Ecosystems, *Water pollution effects, Chromophoric materials, Colorants, Aquatic environment, Environment.

Modern colorants use a variety of chromophoric groups which in turn, may carry a wide range of substituents, both to influence the color, and to provide the required properties for dyeing particular substrates. Thus, there are many thousands of different substances used as commercial clorants. Further, the introduction of new structures to meet particular demands for shade and application is still in an area of major innovative activity. However, in general, individual products have a relatively low sales volume and the strategy which has been developed to assess the effect of dyestuffs (water-soluble, or water-dispersible, colorants) in the environment must necessarily be different from that appropiate for, say, pesticides. The paper discusses this strategy and shows how a 'base set' package of data, the concept of which was developed by the clorant industry years ahead of the '6th Amendment' Directive, may be used to assess the possible effects of a specific dyestuff when discharged in an aqueous effluent. As a second part of the strategy, the paper addresses more general questions relating to the ultimate fate of dyestuffs when discharged in aqueous effluents and in particular considers their most likely environmental distribution, their potential for bioaccumulation, and their biodegradability. (Author's abstract)
W88-03663

BIOCONCENTRATION OF ALCOHOL ETHOXYLATES IN CARP (CYPRINUS CARPIO),
Tokyo Metropolitan Research Inst. for Environmental Protection (Japan).
M. Wakabayashi, M. Kikuchi, A. Sato, and T.

Yoshida.
Ecotoxicology and Environmental Safety EESDV, Vol. 13, No. 2, p 148-163, April 1987. 6 fig, 8 tab, 14 ref.

Descriptors: *Water pollution effects, *Path of pollutant, *Isotope studies, *Hydrocarbons, *Detergents, *Surfactants, Alcohol, Fish, Carp, Cyprinus, Alcohol ethoxylates, Biodegradation, Metabolites, Nonionic surfactants, Tracers.

The uptake, distribution, and clearance of three labled nonionic surfactants, 14C-labled dodecyl tetra(Oxyethylene) ether (14C-C12-AE(4)), 14C-labled dodecyl octa(oxyethylene) ether (14C-C12-AE(8)), and 14C-labeled dodecyl hexadeca(oxyethylene) ehter (14C-C12-AE(16)) were investigated in carp (Cyprinus) exposed to concentrations of 0.2-0.6 mg per liter, using whole-body autoradiography and the liquid scintillation counting method. 14C radioactivity was rapidly absorbed into the fish body and distributed in the skin, nasal and oral cavities, gills, brain, hepatopancreas, kidney, gall bladder, and intestinal content at comparatively high concentrations. The calculated wet weight whole-body bioconcentration factor at steady state in the fish exposed to 14C-C12-AE(4), 14C-C12-AE(8), or 14C-C12-AE(16) for 72 hr was 310, 220, or 4.3 respectively. Clearance of 14C radioactivity from the fish body was rapid, with half-lives of 30-80hr. The metabolites of 14C-C12-AE(4) were also examined in gills, blood, kidney, hepatopancreas, or gall bladder using thin-layer chromatography. (Author's abstract)
W88-03664

EFFECT OF LINEAR ALKYL BENZENE SULFONATE IN SKIN OF FISH FINGERLINGS (CIRRHINA MRIGALA): OBSERVATIONS WITH SCANNING ELECTRON MICROSCOPE,
Industrial Toxicology Research Centre, Lucknow (India).
V. Misra, G. Chawla, V. Kumar, H. Lal, and P. N. Viswanathan.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 164-168, April 1987.

Descriptors: *Water pollution effects, *Detergents, *Pollutants, *Hydrocarbons, Biodegradation, Fish, Cirrhina, Fish fingerlings, Benzene sulfonate, Skin, Electron microscopy, Mucus, Electron microscope.

Pathomorphological changes in the skin was noticed under the scanning electron microscope in fish fingerlings (Cirrhina mrigala) exposed to 0.005 ppm (25 percent of the LC50) concentration to linear alkyl benzene sulfonate. The epitheal cells present in the epidermis of the skin were found to secrete more mucas with linear alkyl benzene sulfonate (LAS) than did controls. The presence or disposition of mucus on the surface of skin indicated likely molecular interaction between constituents of mucus and LAS. (Author's abstract)
W88-03665

HISTOPATHOLOGICAL CHANGES IN LIVER AND THYROID OF THE TELEOST FISH, CHANNA PUNCTATUS (BLOCH), IN RESPONSE TO AMMONIUM SULFATE FERTILIZER TREATMENT,
Banaras Hindu Univ., Varanasi (India).
R. N. Ram, and A. G. Sathyanesan.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 185-190, April 1987. 10 fig, 15 ref.

Descriptors: *Water pollution effects, *Sulfates, *Pollutants, *Fish toxins, *Fertilizers, *Ammonium sulfate, Liver, Thyroid, Fish, Channa, Pollution, Bioassay, Sublethal concentrations.

In Channa panctatus exposed to safe (100 ppm) and sublethal (500 ppm) concentrations of the commonly used fertilizer ammonium sulfate for 6 months, from January to June, hepatocytes revealed initial hypertrophy followed by exaustion as evidenced by deranulation, nuclear pyknosis, and focal necrosis. Thyroid follicles exhibited various degrees of hypertrophy, hyperplasia, hyperemia, and reduction in colloid content. In both the liver and the thyroid, changes were more pronouced in the 500-ppm-treated fish. These results suggest that this fertilizer, which is washed into the water system in small quantities, may cause dose-dependent dysfunction of liver and thyroid. (Author's abstract)
W88-03666

EFFECTS OF THIOSEMICARBAZIDE ON DEVELOPMENT IN THE WOOD FROG, RANA SYLVATICA,
Wisconsin Univ.-Eau Claire.
E. E. Riley, and M. R. Weil.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 202-207, April 1987. 2 tab, 13 ref.

Descriptors: *Carbazides, *Water pollution, *Toxicity, *Pollutants, *Frogs, *Hydrocarbons, Tadpoles, Thiosemicarbazide, Wood frog, Rana, Deformities.

Wood frog (Rana sylvatica) tadpoles were exposed to 50mg thiosemicarbazide (TSC)/liter water for varying lengths of time and at different developmental stages. Short exposure periods (3 and 6hr) displayed no visible deformaties. Exposure periods of 12 or more hr caused slight to severe abnormalities, with a direct relationship between length of exposure and degree of deformity. Tadpoles exposed to TSC from posthatching days 24-30 were more seriously affected than were tadpoles exposed at an older age. (Author's abstract)
W88-03667

EFFECTS OF THREE RELATED AMIDES ON MICROECOSYSTEM STABILITY,
Minnesota Univ.-Duluth. Dept. of Biology.
T. F. Flum, and L. J. Shannon.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 2, p 239-252, April 1987. 5 fig, 3 tab, 44 ref.

Descriptors: *Water pollution effects, *Pollutants, *Aquatic environment, *Microorganisms, *Amides, *Toxicity, Microenvironment, Ecosystems, oxygen, Diuron, Acetanilide, Salicylanilide.

Three related amides (diuron, 2-(octyloxy) acetanlide, and salicylanilide) were evaluated for toxicity to aquatic microcosm communities. Effects were measured at the ecosystem level using changes in pH, Eh (redox potential), and dissolved oxygen as indicators of toxicity. These values were used to calcualte the resistance, resilience, and relative instability of the microecosystems to each compound at comparable dose levels of approximately 2500 mg/liter. Such measures have often been used in a theoretical context, but have not received wide practical application. The systems displayed low resistance and no response to diuron, high resistance and low resilience to 2-(octyloxy) acetanilide, and no response to salicylanilide. At a higher exposure level (9800 microgram/l salicylanilide), the systems showed low resistance and high resilience. Both this approach and more traditional dose-response measures of toxicity indicated that diuron was clearly the most toxic compound, followed by 2-(octyloxy) acetanilide and salicylanilide. While microcosm toxicity tests were slightly less sensitive than some single species tests, they provided important additional information on the extent of perturbations and the rate of ecosystem recovery. (Author's abstract)
W88-03670

RELATIONSHIP OF FLUORIDE IN DRINKING WATER TO OTHER DRINKING WATER PARAMETERS,
Iowa Univ., Oakdale. Dept. of Preventative Medicine and Environmental Health.
C. F. Lynch.
Archives of Environmental Health AEHLAU, Vol. 42, No. 1, January 1987. 2 fig , 6 tab, 23 ref.

Descriptors: *Water pollution effects, *Pollution, *Drinking water, *Fluoridation, *Fluorides, *Water treatment, Potable water, Radium, Strontium, Nitrogen.

Fluoride in drinking water and 32 other drinking water variables were evaluated in an epidemiologic study of 158 municipalities in the State of Iowa. The study included 3 study groups: two for controlled fluoridation and one for natural fluoride. Previous epidemiologic studies of fluoride in drinking water parameters. The results indicated that controlled fluoridation municipalities were more likely to have initiated other treatment practices such as chlorination. Natural fluoride drinking water concentrations were positively correlated with water source depth, and thereby related to other depth-associated variables such as radium 226, strontium, and nitrogen. Future epidemiologic studies evaluating the safety of fluoride in drinking water should address the potential for confounding by other water variables and treatment processes. (Author's abstract)
W88-03671

EFFECT OF PETROLEUM HYDROCARBONS ON ATLANTIC COD, GADUS MORHUA, FOLLOWING CHRONIC EXPOSURE,
Department of Fisheries and Oceans, St. John's (Newfoundland).
J. W. Kiceniuk, and R. A. Khan.
Canadian Journal of Zoology CJZOAC, Vol. 65, No. 3, p 490-494. March 1987. 4 tab, 23 ref.

Descriptors: *Oil spills, *Water pollution effects, *Oil wastes, *Pollutants, *Hydrocarbons, Atlantic cod, Pollution, Fish, Gadus, Ecosystems, Gametogenesis, Mortality, Bioaccumulation.

Experiments were conducted to ascertain the effects of crude oils at low concentrations on Atlantic cod (Gadus morhua) following long-term exposure (3-21 weeks) in a flow-through seawater sytem. Control and oil-treated fish were fed to satiation. Effects were assessed by comparing condition factor, organ indices, and hematological values with those of corresponding control animals. No mortality occured but food consumption was significantly reduced in oil-treated cod, especially during summer-autumn. Condition factor and somatic indices of some organs were lower in oil-treated fish. Effects of oil exposure were less distict during winter, as food intake in both grups of fish was reduced considerably. The rate of gametogenesis was slower in male cod exposed to oil fractions in summer-autumn whereas spermeation was delayed in fish treated in winter-spring. These studies provide evidense that feeding, growth, and reproduction in male cod are biologically important variables that are affected following chronic exposure to petroleum. (Author's abstract)
W88-03673

LETHAL EFFECTS OF VANADIUM TO TWO LIFE STAGES OF BROOK TROUT SALVELINUS FONTINALIS (MITCHILL),
Environmental Protection Service, Dartmouth (Nova Scotia).
W. R. Ernst, and E. T. Garside.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 3, p 628-634, March 1987. 2 fig, 3 tab, 40 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Pollutants, Trout, *Brook trout, *Vanadium, Metals, Fish, Salvelinus, Food chains, Toxicity, Alevins, Acidity, Yearlings.

Alevins of brook trout (Salvelinus fontinalis) were less sensitive to vanadium than were yearlings, the 96th-h LC50 being 24 and 7 mg V/L, respectively. 'Lethal thresholds' were not attained during alevin exposures for 33 days and yearling fish exposures for 12 days. Vanadium solutions were also rendred less toxic by the addition of sulfuric acid and sodium hydroxide, suggesting that a toxic effect of vanadium is an increased loss of electrolytes from membrane surfaces. (Author's abstract)
W88-03674

ABUNDANCE, GROWTH, AND FOOD SUPPLY OF WHITE SUCKERS (CATOSTOMUS COMMERSONI) IN RELATION TO LAKE MORPHOMETRY AND PH,

Toronto Univ. (Ontario). Dept. of Zoology.
E. A. Trippel, and H. H. Harvey.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 3, p 558-564, March 1987. 5 tab, 44 ref.

Descriptors: *Water pollution effects, *Acidity, *Limnology, *Pollutants, *Hydrogen ion concentration, Fish, Lakes, Lake morphometry, Lake fisheries, Food chains, Food supply, White suckers, Catostomus, Ontario.

Associations between the abundance, body growth, and food supply (chrinonomid and ephemeropteran larvae) of white suckers, and lake morphometry and water chemistry were determined for eight Ontario lakes. White sucker abundance was low in three deep-acid lakes, intermediate in two deep-circumneutral lakes, and high in three shallow-acid lakes. Abundance was negatively correlated with both maximum lake depth (r = -0.71) and mean lake depth (r = -0.67) and positively correlated with the morphoedaphic index (r = 0.67). Generally, 4-year-old white suckers were largest in deep-acid lakes, intermediate in size in deep-circumneutral lakes, and smallest in shallow acid lakes. Fork length and somatic weight at age 4 were negatively correlated with white sucker abundance (r = -0.76 and -0.80, respectively), positively correlated with density of chironomid larvae (r = 0.62 and 0.68, respectively), and negatively correlated with pH (r = -0.67 and -0.70, respectively). The von Bertalanffy estimates of maximum attainable fork length for both sexes were considerably larger in both deep-acid and deep-circumneutral than in shallow-acid lakes. Correlations indicated that oligotrophic lakes contain white suckers with a large fork length, the strongest correlation being with maximum lake depth. (Author's abstract)
W88-03675

DEPOSITION OF ALUMINUM IN THE GILL EPITHELIUM OF RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON) SUBJECTED TO SUBLETHAL CONCENTRATIONS OF THE METAL,

Toronto Univ. (Ontario). Dept. of Zoology.
J. H. Youson, and C. M. Neville.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 3, p 647-656, March 1987. 12 fig, 35 ref.

Descriptors: *Pollutants, *Water pollution effects, *Acidity, *Acid rain, *Aluminum, *Rainbow trout, Toxicity, Trout, Fish, Epithelium, Gills, Salmo, Metals, Pollution, Hydrogen ion concentration.

Rainbow trout (Salmo gairdneri Richardson) were exposed to acid and sublethal concentrations of inorganic aluminum (1.6 micromolar at pH 6.1;2.8 micromolar at pH 5.5, 5.0, and 4.5); aluminum was also administered in combination with organic acid at pH 4.5 and 5.0. The gill epithelium was examined by transmission electron microscopy and by electron probe X-ray microanalysis. Control fish at pH 7.3 without aluminum showed normal morphology but increased acidity and (or) decreased hardness resulted in a greater exposure of chloride cells at the epithelial surface. All fish exposed to aluminum had electron-dense particles on the surface of the respitory (pavement) epithelial cells and chloride cells of the gills and most cells had these deposits in varying concentrations within cytoplasmic vacuoles and dense bodies. It was shown by X-ray microanalysis that the deposits contained aluminum. Increased acidity did not alter the pattern of distribution of aluminum particles but a heavy concentration of this metal followed the addition of organic acid. The accumulation of aluminum on and within epithelial cells and increased exposure of chloride cells in the gills might reflect decreased oxygen uptake and increased ion loss in trout, and probably are responsible for the toxicity of aluminum to fish in acid environment. (Author's abstract)
W88-03676

IMMUNOTOXICOLOGIC EVALUATION OF CHLORINE-BASED DRINKING WATER DISINFECTANTS SODIUM HYPOCHLORITE AND MONOCHLOROAMINE,

Idaho Univ., Moscow.
J. H. Exon, L. D. Koller, C. A. O'Reilly, and J. P. Berer.
Toxicology TXCYAC, Vol. 44, No. 3, p 257-269, June 1987. 5 tab, 26 ref.

Descriptors: *Water treatment, *Disinfection, *Chlorine disinfectants, *Drinking water disinfectants, *Sodium hypochlorite, *Monochloroamine, Immunology.

Male Sprauge-Dawley rats were exposed to chlorine-based disinfectants in the drinking water from weaning to 12 wk old, at which time they were killed and assessed for immune competence. The disinfectants used were: sodium hypochlorite (5, 15, and 30 ppm) and monochloramine (9, 19, 38 pmm). Significant reductions of spleen weight, delayed-type hypersensitivity reactions, and oxidative metabolism by macrophages were observed only in groups of rats exposed to high levels (30 pmm) of sodium hypochlorite, while prostagland E2 (PGE2) production was elevated. Rats exposed to the higher doses of monochloromine had reduced spleen weights (38 ppm), decreased antibody synthesis (9 and 19 ppm) and augmented PGE2 production (19 and 38 ppm). These types of effects on the immune system are a previously unrecognized potential side-effect of the ubiquitous practice of disinfection of water with chlorine compounds. The subtle toxic effects of these chemicals that result from long-term, long-level exposure must be fully realized before other proposed uses of chlorine are acceptable, such as for deodorization of disinfection of industrial waste waters. These uses would greatly increase the amount of chlorine and chlorine reaction products in the aquatic environment. Additional studies may be warranted to assess the effects of chronic low level exposure to these compounds in several species. (Peters-PTT)
W88-03686

GROWTH AND AGGREGATION BEHAVIOR OF REPRESENTATIVE PHYTOPLANKTON AS AFFECTED BY THE ENVIRONMENTAL CONTAMINANT DI-N-BUTYL PHTHALATE,

California State Univ., Long Beach. Dept. of Chemistry.
R. Acey, P. Healy, T. F. Unger, C. E. Ford, and R. A. Hudson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 1-6, July 1987. 1 fig, 1 tab, 11 ref. March of Dimes Birth Defects Foundation grant No. 15-48.

Descriptors: *Dialkylphthalates, *Phytoplankton growth, *Water pollution effects, *Marine algae, Cyanophyta, Diatoms, Chlorophyta, Environmental contaminants, Brine shrimp, Aquatic species.

The surface waters of the Gulf of Mexico contain approximately 1 microgram of di-n-butyl phthalate per liter. In some fresh waters, in Lake Superior, for example, the concentration of this chemical was found to be even higher, 0.3 ppm. Blue-green and green algae and diatoms at initial concentrations of 200-7--/microliter in modified artificial sea water media were exposed to the following concentrations of di-n-butyl phthalate (DNBP): 10, 25, 50, and 100 microM for Thalassioria pseudoma, 1 and 10 mircoM for Dunaliella parva, 10, 100, and 500 nM, and 1 and 10 miroM for Synechococcus lividus. DNBP markedly affected the growth and/or aggregation behavior of the algae and diatom species studied. If the sensitivity of fresh water phytoplankton is similar to that observed in this study, then the disapperance of various aquatic species from lakes and streams may be linked to the level of phthalates now present. Given the rate of oceanic contamination by phthalates, these substances could alter the distribution of the salt water phytoplankton. (Peters-PTT)
W88-03687

NET SODIUM LOSS AND MORTALITY OF THREE SALMONID SPECIES EXPOSED TO A STREAM ACIDIFIED BY ATMOSPHERIC DEPOSITION,

Pennsylvania State Univ., University Park.
C. J. Gagen, and W. E. Sharpe.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, July 1987. 2 fig, 3 tab, 17 ref.

Descriptors: *Alumunium, *Acid rain, *Water pollution effects, *Acid rain effects, *Sodium balance, *Mortality, *Acid streams, *Atmospheric deposition, Trout, Toxicity.

Toxicological studies indicate that aluminum which is organically bound is not toxic, whereas, exposure of brook trout to inorganically complexed and free aluminum ions can result in measurable reduction in growth and survival. Death of freshwater fish exposed to low hydrogen ion concentration is primarily due to failure of sodium regulation. Low hydrogen ion concentration reduce sodium influx and greatly increase efflux resulting in a net loss of sodium. Ionoregulatory failure may trigger circulatory collapse which finally causes death. A study was conducted to determined whether or not aluminum accelerates net sodium loss in fish exposed to pH 5.0 soft water (calcium > 5 mg/L) and if so, to discover whether or not the magnitude of loss might account for mortality of fish in waters acidified by atmospheric deposition. The laboratory experiments, using fingerling brook trout, show that in the absence of added chelating agents, ambient aluminum could account for severe body sodium depletion at pH 5.0. Results also indicate that elevated aluminum concentrations due to acidification can cause fish mortality by interfering with ionoregulation. (Ray-PTT)
W88-03688

ACUTE TOXICITY OF GARLON 4 AND ROUNDUP HERBICIDES TO SALMON, DAPHNIA, AND TROUT,

Department of Fisheries and Oceans, Cultus Lake (British Columbia). Cultus Lake Salmon Research Lab.
J. A. Servizi, R. W. Gordon, and D. W. Martens.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 15-22, July 1987. 6 tab, 11 ref.

Descriptors: *Herbicides, *Water pollution effects *Toxicity, *Aquatic life, Garlon 4, Roundup, Salmon, Daphnia, Trout, Hydrogen ion concentration, Temperature effects.

Canadian Forest Service and the British Columbia Ministry of Forest are evaluating the herbicides Garlon 4 and Roundup for control of deciduous trees and bushes in areas to be reforested with conifers. The toxicity of these two herbicides, was studied in salmon, daphnia and trout fingerlings. The toxicity of Garlon 4 depended upon its rate of hydrolysis which is dependent on temperature and pH. The products of hydrolysis are less toxic than the parent compound. The herbicide Roundup is a mixture of glyphosate and a surfactant both of which are toxic and in natural water their combined effects were 'more than additive' which is contrary to the results of other studies. (Ray-PTT)
W88-03689

ACUTE LETHAL TOXICITY OF SOME REFERENCE CHEMICALS TO FRESHWATER FISHES OF SCANDINAVIA,

Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-03690

FATE OF 7,12-DIMETHYLBENZ(A)ANTHRACENE IN RAINBOW TROUT, SALMO GAIRDNERI,

New York Univ. Medical Center, Tuxedo Park. Lab. of Environmental Studies.
For primary bibliographic entry see Field 5B.
W88-03691

ACID-SHOCK, ALUMINIUM, AND PRESENCE OF SPHAGNUM AURANTIACUM: EFFECTS EMBRYOLOGICAL DEVELOPMENT IN THE COMMON FROG, RANA TEMPORAIA AND THE MOOR FROG, RANA ARVAILS,

Goeteborg Univ. (Sweden). Dept. of Zoology.

M. Olsson, C. Hogstrand, A. Dahlberg, and S. Berglind.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 1, p 37-44, July 1987. 3 fig, 2 tab, 1 ref.

Descriptors: *Acid rain, *Acid, *Aluminum, *Water pollution effects, *Sphagnum Aurantiacum, Embryological development, Common frog.

Acidification of natural waters results in, among other things, enhanced leaching of metal from soil and sediments. Increased acidity also favors growth of mosses. Toxicity of aluminum at low hydrogen ion concentration (below 5.5) is well known. The unusually high mortality of frog spawn when deposited on mosses has raised the possibility that these mosses reinforce the detrimental effects of acidification on Auran reproduction. The authors undertook the present study to determine this possibility. They used two species of known composition and acidity. Aluminum composition of the water was varied over several concentrations. The impact of moss was also studied and it was concluded that the apparent property of moss to keep hydrogen ion concentration low in its surrounding might be the reason for the decreased hatching success in frog spawn deposited on the mosses. (Ray-PTT)
W88-03692

ZINC SENSITIVITY OF A FRESHWATER SNAIL, LYMNAEA LUTEOLA L., IN RELATION TO SEASONAL VARIATIONS IN TEMPERATURE,
Industrial Toxicology Research Centre, Lucknow (India).
B. S. Khangarot, and P. K. Ray.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 45-49, July 1987. 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Zinc, *Toxicity, *Freshwater snails, *Seasonal variation, *Temperature effects, Aquatic food chain, Cellular enzymes.

The effects of temperature on zinc sensitivity of freshwater adult pond snails was tested in waters of known physico-chemical properties. Ten snails were exposed at a time to each concentration of zinc (as Zn SO4 7H20; 1 to 28 mg/L). The temperture variations were achieved by conducting the experiments from November (warm) to July (hot). The increased susceptibility of snails to zinc at higher temperature may be due to the increased oxygen demand by snails accompanied by lowered solubility of oxygen in water at these higher temperatures. The increased metabolism at these temperature would also increase the uptake of zinc which circulates in the body system, thereby causing higher toxicity. (Ray-PTT)
W88-03693

COPPER TOXICITY TO THE FRESH WATER SNAIL, LYMNAEA LUTEOLA,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
N. M. Reddy, and by P. V. Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 1, p 50-55, July 1987. 2 tab, 19 ref.

Descriptors: *Copper, *Toxicity, *Freshwater snails, *Heavy metals, *Snails, *Bioaccumulation, *Water pollution effects, Enzymes, Detoxification.

Snails (Lymnaea luteola) weighing 300-400 mg with the shell were exposed to copper sulfate solutions (2mg/L) for 6 hr to study the influence of copper on some of the enzymes of fresh water snails. Exposure to copper sulfate solutions increased the activities of tri- and diglyceride acylhydrolases and phospholipase. There was a corresponding decrease in the glycerides and phospholipids and and increased level of free fatty acids of the snails occurred. The elevation of free fatty acid levels was probably due to increased lipase activity in the copper-treated snails involved in complexing copper for storage or detoxification. (Ray-PTT)
W88-03694

TOTAL AND METHYL-MERCURY CONTENT IN BIVALVES, MYTILUS GALLOPROVINCIALIS LAMARCK AND OSTREA EDULIS LINNAEUS: RELATIONSHIP OF BIOCHEMICAL COMPOSITION AND BODY SIZE,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
M. Najdek, and J. Sapunar.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 56-62, July 1987. 4 tab, 16 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Mussels, *Oysters, *Bivalves, *Mercury, *Methyl mercury content, *Bioaccumulation, *Mercury, Heavy metals.

The relationship between total and methyl mercury content and body mass was investigated in mussels and oysters of the Limski kanal in northern Adriatic sea. Oysters were more effective bioaccumulators than mussels before the spawning season. In both species, total and methyl-mercury content increased in correlation with dry weight. Greater methyl-mercury changes were measured in the larger mussels during the reproductive period, but in oysters no such effect was noted. In both species the mercury content was influenced by the events of the reproductive cycle. (Ray-PTT)
W88-03695

FACTORS INFLUENCING THE SELECTION OF APPROPRIATE SANITATION TECHNOLOGY,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5D.
W88-03718

OXYGEN DEPLETION MODELLING, PORT SHELTER, HONG KONG,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5B.
W88-03733

CHIRONOMID MORTALITY AFTER THE SANDOZ ACCIDENT AND DEFORMITIES IN CHIRONOMUS LARVAE DUE TO SEDIMENT POLLUTION ON THE RHINE,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
G. van Urk, and F. C. M. Kerkum.
Aqua AQUAAA, No. 4, p 191-196, 1987. 6 fig, 4 tab, 13 ref.

Descriptors: *Pesticides, *Insecticides, *Chironomids, *Sandoz accident, *Rhine River, *Water pollution effects, *Bioindicators, Sediments, Mortality, Toxicity, Organic compounds, Larvae.

Midge larvae (Diptera: Chironomidae) prove to be useful indicators of toxic substances in the Rhine. After the Sandoz accident, when large quantities of insecticides were discharged into the Rhine at Basel, acute mortality of chironomid larvae was observed as far as 800 km downstream. Chironomus larvae from Rhine sediments in the Netherlands show high percentages of deformities of the mouth parts. No development of these larvae into pupae was observed. In another Chironomus population, indications were found that deformed larvae are less viable than non-deformed larvae. Deformity incidence in Chironomus larvae may be a useful index for the presence of toxic substances in water reservoirs. (Author's abstract)
W88-03763

LEGACY OF WELL-WATER METHEMOGLOBINEMIA,
Vanderbilt Univ., Nashville, TN. School of Medicine.
J. N. Lukens.
Journal of the American Medical Association JAMAA, Vol. 257, No. 20, p 2793-2795, May 22/29 1987. 8 ref.

Descriptors: * Methemoglobinemia, *Well-water, *Nitrates, *Human diseases, *Drinking water, Iowa City, Big Sioux River Basin, South Dakota.

Methemoglobinemia (cyanosis) in infants can either be hereditary or acquired. The vast majority of methemoglobinemia cases in infants are acquired and are caused by the nitrate ions in the drinking water. A 1981 survey of more than 1000 wells in the Big Sioux River Basin of South Dakota disclosed that 27% were contaminated by nitrates in concentrations that exceed the EPA permissible limit. Even 42 years after the characterization of well-water cyanosis, nitrate-contaminated well water remains one of the more common causes of acquired methemoglobinemia in infants. (Ray-PTT)
W88-03843

FATAL OUTCOME OF METHEMOGLOBINEMIA IN AN INFANT,
South Dakota State Dept. of Health, Pierre.
C. J. Johnson, P. A. Bonrud, T. L. Dosch, A. W. Kilness, and K. A. Senger.
Journal of the American Medical Association JAMAA, Vol. 257, No. 20, p 2796-2797, May 22/29, 1987. 7 ref.

Descriptors: *Methemoglobinema, *Human diseases, *Rural areas, *Well water, *Nitrates, *Water pollution soruces, *Path of pollutants, Drinking water, Water pollution treatment, Agricultural runoff, Fertilizers.

A survey of physicians in South Dakota indicates large number of methemoglobinemia cases in infants. This preventable, treatable intoxication continues to contribute to infant mortality. The cause of this intoxication is the nitrate ion in drinking waters of rural South Dakota, Minnesota, Nebraska and Iowa where a large proportion of the population depends on water from individual wells. Contamination by nitrate ions most often occurs during flooding, when runoff may contain chemical fertilizers from nearby cultivated fields. Most of the contaminated wells are shallow; wells $>$ 100 ft deep are relatively safe. Of 1,000 wells surveyed by the South Dakota Department of Water and Natural Resources, 4% contain nitrate ions at $>$ 100 ppm, 9% at $>$ 50 ppm, 17% at $>$20 ppm, and 27% at $>$ 10 ppm, the EPA maximum contaminant level. Removal of nitrates from contaminated wells requires extensive treatment, for example, deionization, reverse osmosis, etc., but not simple in-line filtration. (Ray-PTT)
W88-03844

CYANOBACTERIAL WATER-BLOOMS,
Freshwater Biological Association, Windermere (England).
C. S. Reynolds.
Advances in Botanical Research, Vol. 13, p 67-143, 1987. 12 fig, 3 tab, 368 ref, append.

Descriptors: *Lakes, *Eutrophication, *Cyanophyta, *Fresh water algae, *Stokes equation, *Adaptation, Evolutionary strategies, Algae, Buoyancy, Nutrients, Population dynamics.

Inflow of nutrient rich effluents from catchments, sewage disposal plants and leachings from cultivated lands is now causing water-bloom formation in fresh water lakes. The explosive growth of the ancient species of blue-green algae is the cause of this water-bloom phenomenon. Because of the presence of gas-filled intracellular molecules in these algae they float and move across the water surfaces very easily. Buoyancy, population dynamics and perennation of these algaes in natural limnetic environments are reviewed. The buoyant properties of the algae are assessed in relation to the Stokes Equation, drawing distinctions between the differential contributions of size, density and form resistance among individual genera. Density of the algae changes through the erection or collapse of gas vesicles, their dilution by growth and through the maintenance of glycogen ballast. An empirical equation describing movements of the algae in the lakes was developed. The effects of temperature, light and nutrients on growth of the algae and their responses to deficiencies of slurry are also reviewed. The result of limiting resources on the buoyancy regulation was modeled. Adaptations for perennation and re-establishment of popu-

lations after bloom formation or other adverse conditions are reviewed. (Ray-PTT)
W88-03845

MIXTURE TOXICITY INDICES IN ACUTE LETHAL TOXICITY TESTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5A.
W88-03866

ASSESSMENT OF THE BIOLOGICAL IMPACT OF POINT SOURCE DISCHARGES EMPLOYING ASIATIC CLAMS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5A.
W88-03867

CHANGES IN THE AQUEOUS BEHAVIOR OF PARATHION UNDER VARYING CONDITIONS OF HYDROGEN ION CONCENTRATION,
Ohio State Univ., Columbus. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W88-03869

CADMIUM KINETICS IN FRESHWATER CLAMS. III EFFECTS OF ZINC ON UPTAKE AND DISTRIBUTION OF CADMIUM IN ANODONTA CYGNE,
Utrecht Rijksuniversiteit (Netherlands). Lab. of Chemical Animal Physiology.
J. Hemelraad, H. A. Kleinveld, A. M. de Roos, D. A. Holwerda, and D. I. Zandee.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 16, No. 1, p 95-101, January 1987. 8 fig, 1 tab, 15 ref.

Descriptors: *Freshwater clams, *Cadmium, *Clams, *Toxicity, *Path of pollutants, Aquatic organisms, Tissue analysis, Heavy metals.

Zinc has an antagonistic and protective action in the uptake and toxic effects of cadmium. With respect to the uptake of cadmium by aquatic organisms, differing effects of zinc coexposure have been reported. In order to determine the effects of zinc on the uptake of cadmium, freshwater clams were exposed to a cadmium solution (25 microgram/L) and a mixture containing 25 microgram/L of cadmium and 2.5 mig/L of zinc. In the presence of zinc, uptake of cadmium in the whole clam was halved. In organs such as the gills, mantle, and labial palps a still larger reduction of cadmium accumulation occurred. By contrast, accumulation in midgut gland and kindey was hardly affected by the presence of zinc. In the gills zinc competes with cadmium for metal binding sites both within the particulate fraction and the high-molecular weight fraction of the cytosol. Zinc probably did not induce an enlarged synthesis of specific metal-binding, metallothionein-like proteins. Zinc exerts antagonistic effects on uptake of cadmium by gills, and accelerates cadmium transport from the gills towards internal organs. (Ray-PTT)
W88-03870

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WATER AND SEDIMENT IN SCOFIELD RESERVOIR, CARBON COUNTY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2H.
W88-03897

MULTIVARIATE APPROACH TO THE INVESTIGATION OF NUTRIENT INTERACTIONS IN THE BARATARIA BASIN, LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
A. S. Witzig, and J. W. Day.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183232/AS. Price codes: A03 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute Partial Completion Report, Baton Rouge. April 1983. 36 p, 4 fig, 5 tab, 42 ref. Project No. OWRT A-047-LA (3).

Descriptors: *Multivariate analysis, *Nutrients, *Dredging, *Agricultural runoff, *Urban planning, *Water pollution effects, *Seasonal variation, Spatial distribution, Statistical methods, Chemical properties, Conductivity, Eutrophication, Nitrogen, Phosphorus, Chlorophyll, Salinity, Dissolved oxygen, Estuaries.

A study of nutrient chemistry in the Barataria basin was designed to show seasonal and spatial variability along a fresh to saltwater gradient and to assess the impact of dredging, agricultural runoff and urban development on the water chemistry of the system. Twenty-three sampling stations were sampled in 1975-1977 along a 120 km transect. Parameters measured included total and dissolved organic N, total P, nitrate-N, nitrite-N, ammonium N, chlorophyll a, secchi depth, salinity, conductivity, dissolved oxygen and temperature. Multivariate statistical techniques were used to provide a holistic approach to the interpretation of chemical data. Natural groupings of water bodies were derived by a cluster analysis with the variables: total organic N, total inorganic N, total P, secchi depth and chlorophyll a. Factor analysis defined patterns which suggested that upland runoff and algal growth were major processes. A source-sink empirical model described the changes in nutrients through the system. The analyses suggested that the variation in water chemistry between the upper and lower basin would be much less with fewer human impacts. (Geiger-PTT)
W88-03936

MOUNT ST. HELENS: THE AFTERMATH,
Office of Water Research and Technology, Washington, DC.
D. C. Flaherty.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-182340/AS. Price codes: A04 in paper copy, A01 in microfiche. (1983). 65 p. Project No. BuRec C-00217-V (0534)(1).

Descriptors: *Volcanoes, *Air pollution, *Water pollution effects, *Mudflows, *Ecological effects, *Washington, *Oregon, *Montana, Ash, Aquatic animals, Computer models, Fish behavior, Fisheries, Environmental effects, Flooding, Groundwater pollution, Irrigation efficiency.

During the May 18, 1980 eruption of Mount St. Helens, ash fell over a 100,000 sq mi area to the east. The U. S. Congress appropriated funds for research to be administered through the Office of Water Research and Technology. In October 1981, a conference was held in Portland, Oregon to disseminate some of the findings of this research. The Idaho studies showed that, although the ashfall altered the food chains of some forest streams, within a year they fully recovered. The effects of ashfall on lake benthic organisms are still being assessed by sediment sampling. The Montana studies reported on snow avalanche models adapted to mudflows, trophic impact of ash deposits on Montana lakes, and the volcanic ash as nutrient subsidy to sub-alpine lakes. The Oregon studies reported on herring and smelt egg and larvae damage due to suspended ash. The drainage patterns in eruption debris were studied along with the filling of Columbia River berths with ash. The Washington studies have found that phenolic compounds from fallen timber could contaminate downstream fish. The homing instinct of salmon did not seem disrupted by ash in the streams, however the presence of ash slowed migration in laboratory tests. Computer forecasting models of mudflows, and the effects of mud and/or ash on groundwater, aquatic animals, irrigation efficiency, and flooding were also examined. (Geiger-PTT)
W88-03937

GEOLOGICAL ASPECTS OF ACID DEPOSITION.
For primary bibliographic entry see Field 5B.
W88-03961

CHRONOLOGY, MAGNITUDE AND PALEOLIMNOLOGICAL RECORD OF CHANGING METAL FLUXES RELATED TO ATMOSPHERIC DEPOSITION OF ACIDS AND METALS IN NEW ENGLAND,
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W88-03963

ACID RAIN NEUTRALIZATION BY GEOLOGIC MATERIALS,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W88-03964

ION BALANCES BETWEEN PRECIPITATION INPUTS AND RHODE RIVER WATERSHED DISCHARGES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll, N. M. Goff, and W. T. Peterjohn.
IN: Acid Precipitation Series, Volume 7: Geological Aspects of Acid Deposition, Butterworth Publishers, Boston, 1984. p 77-111, 14 fig, 9 tab, 27 ref.

Descriptors: *Water pollution effects, *Acid rain, *Geochemistry, Soil chemistry, Nutrients, Potassium, Magnesium, Calcium, Forest soils, Rhode River, Maryland, Land use, Ions, Pastures, Cropland, Nitrates, Ecological effects, Precipitation.

A study of the effects of acid precipitation in the Rhode River Estuary, Maryland, showed that increased hydrogen ion inputs are displacing the essential plant nutrients of magnesium, calcium, and potassium. At the present rate of displacement available pools of these minerals in forested areas could be depleted within a few decades, affecting the ecology. Ion losses were proportional to the magnitude of disturbance associated with the three land uses studied. Total cation and anion outputs were lowest from the forest site, similar but higher for the pastureland, and significantly greater in the cropland discharge than either of the other two. (Cassar-PTT)
W88-03966

REGIONAL ASSESSMENT OF SENSITIVITY TO ACIDIC DEPOSITION FOR EASTERN CANADA,
Department of the Environment, Burlington (Ontario). Hydrology Div.
For primary bibliographic entry see Field 5B.
W88-03967

ENGINEERING APPROACHES FOR LAKE MANAGEMENT; VOLUME 1: DATA ANALYSIS AND EMPIRICAL MODELING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow, and S. C. Chapra.
Butterworth Publishers, Boston. 1983. 340 p.

Descriptors: *Water pollution effects, *Water quality control, *Lakes, *Model studies, *Eutrophication, Statistics, Mathematical studies, Uncertainty, Data interpretation, Robustness, Sampling, Phosphorus, Nutrients, Sediments, Lake sediments, Urban runoff, Wastewater treatment, Water pollution sources, Fate of pollutants, Regression analysis, Trophic level, Engineering, Water management, Lake restoration.

The engineering approach to water quality is applied to lake analysis. Important factors are a strong data base, an understanding of model uncertainty, the emphasis on simplicity in modeling, and the specific application of mathematical techniques to eutrophication. Chapters include the scientific method, uncertainty, fundamental statistical concepts, robustness, sampling design, applied regression analysis and linear models, lake quality indices, empirical models for evaluation of trophic

state, and quantitative methods for lake management. (Cassar-PTT)
W88-03983

ENGINEERING APPROACHES FOR LAKE MANAGEMENT; VOLUME 2: MECHANISTIC MODELING,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
S. C. Chapra, and K. H. Reckhow.
Butterworth Publishers, Boston. 1983. 492 p.

Descriptors: *Water pollution effects, *Water quality control, *Lakes, *Model studies, *Eutrophication, Statistics, Mathematical studies, Kinetics, Data interpretation, Input-output analysis, Phosphorus, Nutrients, Sediments, Lake sediments, Food chains, Water pollution sources, Fate of pollutants, Bioaccumulation, Accumulation, Trophic level, Engineering, Water management, Lake restoration, Numerical analysis, Seasonal variation.

The engineering approach to water quality is applied to lake analysis. Important factors are a strong data base, an understanding of model uncertainty, the emphasis on simplicity in modeling, and the specific application of mathematical techniques to eutrophication. Chapters include mechanistic modeling of lake water quality, input-output models, models of spatial resolution (horizontal and vertical), kinetic resolution models (nutrient/food chain, toxic substances), and model implementation. (Cassar-PTT)
W88-03984

EVALUATION OF THE STEEL CREEK ECOSYSTEM IN RELATION TO THE PROPOSED RESTART OF THE L-REACTOR: INTERIM REPORT,
Savannah River Ecology Lab., Aiken, SC.
M. H. Smith, R. R. Sharitz, and J. B. Glidden.
Available from the National Technical Information Service , Springfield, VA 22161, as DE82-015401. Price codes: A07 in paper copy, A01 in microfiche. SREL-11/UC-66e, April 1982. 123 p, 18 fig, 26 tab, 51 ref, 2 append.

Descriptors: *Thermal pollution, *Powerplants, *Nuclear powerplants, *Radioactive wastes, *Temperature effects, Waterfowl, Wetlands, Aquatic habitats, Streams, Marshes, Swamps, Turtles, Fish, Alligators, Water pollution effects.

Information regarding the fall and winter utilization of Steel Creek, Georgia, habitats are presented. Waterfowl use of the creek habitats were extensive during winter 1981-1982. Studies of the American alligator through the winter of 1981-1982 indicated that this species remains active through the winter, rather than undergoing an inactive period in subterranean dens. Studies on the Florida mud turtle indicated that these populations in the Steel Creek area are the northernmost among a series of populations that extends from Florida through the Coastal Plain of Georgia. Fish collections through the fall of 1981 and winter of 1981-1982 yielded 49 species, twelve more than were collected during the preceding summer. (Halterman-PTT)
W88-03989

PHYTOPLANKTON DISTRIBUTION IN THREE THERMALLY DIFFERENT BUT EDAPHICALLY SIMILAR REACTOR COOLING RESERVOIRS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
E. W. Wilde.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-013826. Price codes: A04 in paper copy, A01 in microfiche. DP-MS-82-12, 1982. 52 P, 3 fig, 14 tab, 50 ref. Contract No. DE-ACO9-76SR00001.

Descriptors: *Water pollution effects, *Cooling water, *Thermal pollution, *Phytoplankton, Algae, Species diversity, Temperature effects, Heated water, Nuclear powerplants, Savannah River plant, Species composition, Seasonal variation, Chlorophyta, Nutrients, Water temperature, Cyanophyta, Chlamydomonas, Rhodomonas.

Phytoplankton community structure and the physicochemical characteristics of three reactor cooling reservoirs at the Savannah River Plant, Aiken, South Carolina, were studied during 1978. The thermal regimes in the ponds were as follows: (1) Pond C, 67 ha area and 4 m depth, considerable heating with lake-wide temperatures >30 C, even in winter, (2) Pars Pond, 1012 ha and 6.2 m depth, maximal 5 C increase in one of the three arms, and (3) Pond B, 81 ha and 12 m depth, no thermal effluent received during the study. Considerable spatial and temporal differences in water quality and phytoplankton community structure were observed. However, water temperature independent of other environmental factors, such as light and nutrients, was a relatively unimportant variable for explaining phytoplankton periodicity. Total phytoplankton densities and number of species were consistently higher in Par Pond than in Ponds B and C. A total of 169 taxa representing 88 general and 8 divisions was observed in the 3 ponds. The green alga, Selenastrum minutum, and a flagellated cryptomonad, Rhodomonas minuta, were the only species which reached major status in all three ponds. The green algae Chlamydomonas was dominant in Pond C on all sampling dates. Nutrient levels were higher in the two ponds (Pars and C) receiving makeup water from the Savannah River. Phytoplankton community structure was relatively homogeneous among the heated and unheated arms of Par Pond. (Cassar-PTT)
W88-03990

RATE OF ACIDIFICATION OF AQUATIC ECOSYSTEMS IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W88-04015

CAPACITY OF A SWAMP FOREST TO ASSIMILATE THE TOC LOADING FROM A SUGAR REFINERY WASTEWATER STREAM,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5D.
W88-04073

EFFECTS OF TRICHLOROACETIC ACID, A WIDESPREAD PRODUCT OF CHLORINE DISINFECTION, ON THE DRAGONFLY NYMPH RESPIRATION,
Massachusetts Univ., Amherst. Div. of Public Health.
E. J. Calabrese, C. C. Chamberlain, R. Coler, and M. Young.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 4, p 343-355, May 1987. 2 fig, 15 ref.

Descriptors: *Water pollution effects, *Trichloroacetic acid, *Aquatic insects, *Oxygen uptake, Pollutants, Chlorination, Oxygen, Insects, Aquatic environment, Dragonflies, Bioaccumulation, Ecological effects.

The process of chlorination of water with elevated levels of humic materials results in the formation of the non-volatile product, trichloroacetic acid (TCAA), and other related chlorinated by-products. The discharge of chlorinated effluents into streams is likely to add substantial amounts of these chlorinated products to the aquatic environment. The effect of TCAA on the oxygen uptake of dragonfly nymphs is investigated. A range of TCAA from 1 to 1000 ppb for a 96 hour period was employed using a flow-through system. There is a dose-dependent increase in oxygen use which achieves statistical significance from control values at 100 and 1000 ppb. TCAA is capable of causing environmental physiological alterations in an aquatic model organism in a model flow-through system at environmentally relevant concentrations. (Wood-PTT)
W88-04121

SYNERGISTIC EFFECTS OF PH AND ALUMINUM CONCENTRATIONS ON THE LIFE EXPECTANCY OF TILAPIA (MOZAMBICA) FINGERLINGS,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. I. Murungi, and J. W. Robinson.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 5, p 391-395, July 1987. 3 tab, 6 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Aluminum, *Fish, *Acid rain, Kenya, Pollutants, Acidic water, Mortality, Lethal limit, Tilapia, Aluminum salts, Fish behavior, Toxicity.

Acid precipitation is a worldwide problem which causes acid deposition in aquatic environments resulting in an increase in mortality of aquatic organisms and a decrease in aquatic life. It was shown previously that increasing acidity of the water also caused an increase in the concentration of aluminum ions which was known to increase the mortality rate of golden shiners. The role of aluminum in fish mortality is not well understood and very little research was previously done on the combined effects of pH and aluminum on tropical fish. The Tilapia species which is common in Kenya was used for the experiments because it is less sensitive to most toxic substances than most other aquatic species and therefore it can be concluded that any toxicant that affects the Tilapia will also be toxic to other aquatic organisms. The effect of pH alone, and the effects of aluminum salts at pH 5 and pH 4 are presented. Although the fish survived below pH 5, they were less active and showed less avoidance behavior. At a pH of 5 and above, Tilapia fingerlings could withstand a relatively high concentration of aluminum, but as the pH was decreased below 5, the fish were increasingly more sensitive to even low concentrations of aluminum. The toxic effect of aluminum on fish depends on pH and aluminum, with aluminum nitrate and chloride showing more of a toxic effect than aluminum sulfate at a pH of 5. (Wood-PTT)
W88-04124

EFFECTS OF CRUDE AND FUEL OILS ON THE GROWTH, CHLOROPHYLL 'A' CONTENT AND DRY MATTER PRODUCTION OF A GREEN ALGA SCENEDESMUS QUADRICAUDA (TURP.) BREB,
Gdansk Univ. (Poland). Dept. of Plant Physiology.
Z. Tukaj.
Environmental Pollution (Series A) EPEBD7, Vol. 47, No. 1, p 9-24, 1987. 7 fig, 1 tab, 36 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Chlorophyta, *Algae, Algal growth, Chlorophyll a, Dry matter, Scenedesmus, Hydrocarbons, Dispersion, Chemical analysis, Water analysis.

The growth of Scenedesmus quadricauda algae in a batch culture was examined in the presence of crude oil and fuel oil, added to the cultivation medium in the form of a water-soluble fraction (WSF), water extract (WE), and oil-water dispersion (OWD). On applying various concentrations of oils, a decrease in the number of cells, dry matter and chlorophyll 'a' production, with respect to the cell population was observed. The extent of this decrease depended on the kind and concentration of the soluble and dispersed hydrocarbon fractions and on the proportions in which these occurred in the culture medium. On the other hand, the water extracts of both oils stimulated dry mass and chlorophyll 'a' content with respect to a single cell. This effect was accompanied by increased size of the algal cells. The WSF, WE, and OWD of fuel oil, prepared from 200, 50 and 1 cu cm of oil per 1 cu decimeter of Bold Basal Medium (BBM), respectively, had similar inhibitory effects, which points to the dominant role of oil dispersion in the reduction of algal growth. Chemical analysis of the water extracts of fuel oil revealed the presence of 35 hydrocarbons of various kinds, mainly n-alkanes and polycyclic aromatic hydrocarbons. (Author's abstract)
W88-04127

CORRESPONDENCE BETWEEN URBAN AREAS AND THE CONCENTRATIONS OF

CHLORDANE IN FISH FROM THE KANSAS RIVER,
Kansas Dept. of Health and Environment, Topeka. Div. of Environment.
For primary bibliographic entry see Field 5B.
W88-04131

MUTAGENICITY OF TAMA RIVER SEDIMENTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences.
For primary bibliographic entry see Field 5B.
W88-04133

ACUTE TOXICITY OF ORGANOCHLORINED PESTICIDES TO THE EUROPEAN EEL, ANGUILLA ANGUILLA: THE DEPENDENCY ON EXPOSURE TIME AND TEMPERATURE,
Valencia Univ. (Spain). Dept. of Animal Physiology.
M. D. Ferrando, E. Andreu-Moliner, M. M. Almar, C. Cebrian, and A. Nunez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 365-369, September 1987. 1 fig, 1 tab, 16 ref.

Descriptors: *Water pollution effects, *Pesticide toxicity, *Halogenated pesticides, *Eel, Insecticides, Temperature effects, Pesticides, Organochlorinated pesticides, Toxicity, Fish, Water pollution, Valencia, Spain, Lindane, Endosulfan, Mortality.

The increased use of pesticides in Valencia led to the study of the toxic effects of two commonly used persistent organochlorinated pesticides, lindane and endosulfan, on the European eel, Anguilla anguilla, which is very resistant to aquatic contamination. The effects at three temperatures (15, 22 and 29 degrees C) and four exposure times on the degree of the insecticide toxicity to the fish were examined. The percentages of mortality are calculated after 24, 48, 72 and 96 hours of exposure. Lindane exhibited a negative temperature coefficient of toxicity while endosulfan exhibited a positive temperature correlation. The results indicate that endosulfan is more toxic than lindane and that the application of the insecticides at high and low environmental temperatures is more hazardous for the eels. (Wood-PTT)
W88-04142

ACCUMULATION OF PESTICIDES IN THE ORGANS OF CARP, CYPRINUS CARPIO L., AT 4 DEGREES AND 20 DEGREES C,
Jozsef Attila Univ., Szeged (Hungary). Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W88-04143

EFFECT OF EXPOSURE TO SEVERAL PENTACHLOROPHENOL CONCENTRATIONS ON GROWTH OF YOUNG-OF-YEAR LARGEMOUTH BASS, MICROPTERUS SALMOIDES, WITH COMPARISONS TO OTHER INDICATORS OF TOXICITY,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
P. H. Johansen, R. A. Mathers, and J. A. Brown.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 379-384, September 1987. 1 fig, 20 ref.

Descriptors: *Pentachlorophenol, *Water pollution effects, *Growth, *Fish, Bass, Pollutants, Biocides, Fish physiology, Toxicity, Water pollution.

Pentachlorophenol (PCP) is a general metabolic poison contaminating many aquatic environments since it is used extensively as a biocide with many industrial applications. In previous studies it was found that food conversion efficiency and growth of juvenile largemouth bass were reduced by a 14-day exposure to 50 micrograms/liter (ug/L) PCP. The concentration-response relations of PCP over the short term (14 days) are presented and compared with the effects of a longer (52 days) exposure. Food conversion efficiency and fish growth were significantly affected in a concentration-dependent fashion at concentrations above 10 ug/L; the appropriate equations describing the relationships are given. Because survival of young largemouth bass is strongly influenced by their growth rate, PCP-induced growth rate reduction could have an effect on winter survival. (Wood-PTT)
W88-04144

MODEL CHLORINATION OF PLANT DERIVED PHENOLIC WATER CONTAMINANTS WITH AN ASSESSMENT OF THEIR POTENTIAL TOXICITY TO ESCHERICHIA COLI,
Reading Univ. (England). Dept. of Physiology and Biochemistry.
J. T. Borlakoglu, and R. Kickuth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 393-400, September 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Phenolic compounds, *Chlorination, *Fate of pollutants, *Bacteria, *Water pollution effects, Path of pollutants, Toxicity, Escherichia coli, Bacterial growth, Organic compounds, Chemical reactions, Human physiology, Model studies, Drinking water.

Drinking water is often routinely chlorinated to prevent water-transmittable epidemic diseases, although plant-derived phenolic water contaminants released during annual litter decay may also be chlorinated in the process. The effects of chlorination were, therefore, assessed on seven plant-derived phenolic compounds. The substitution pattern of the parent (non-chlorinated) compounds was correlated to the number of produced chlorophenolic derivatives (structure versus chemical reactivity). The formed chlorophenolic mixtures were applied to Escherichia coli DSM 613 to examine their potential toxic effects. Remarkable differences in the inhibition of bacterial growth was observed ranging from 156 ppm to 1250 ppm. The chlorophenolic mixture produced from 4-hydroxybenzoic acid did not inhibit E. coli growth even at a concentration of $>$ 5000 ppm. The mixture of chlorophenolic derivatives of 4-hydroxycinnamic acid was only toxic at 1250 ppm, while that of 3,4-dihydroxybenzoic acid was highly toxic at a concentration of 156 ppm. Although the bacterial system used to evaluate the potential toxic effects of plant-derived chlorophenolic mixtures has a different type of cell membrane from mammals, the authors suggest possible toxic effects in humans if the chlorophenolic mixtures are consumed. (Wood-PTT)
W88-04146

MERCURY CONTENT IN THE WATER AND MARINE ORGANISMS IN ANGKE ESTUARY, JAKARTA BAY,
Indonesian Inst. of Sciences, Djakarta. Lab. of Environmental Study.
For primary bibliographic entry see Field 5B.
W88-04148

PHYSIOLOGICAL STRESS INDUCED BY VEGETABLE OIL FACTORY EFFLUENT IN CHANNA PUNCTATUS (BLOCH): MEASUREMENT OF HEPATIC DEHYDROGENASES,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
S. Gupta.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 3, p 417-424, September 1987. 3 tab, 14 ref.

Descriptors: *Water pollution effects, *Food-processing wastes, *Fish physiology, *Fish, *Vegetable oil industry, Industrial wastes, Effluents, Enzymes, Dehydrogenase, Stress, Water pollution, Pollutants, Liver, India, Satluj River, Metabolism.

The in vivo effects of vegetable oil factory effluent on hepatic dehydrogenases, the enzymes involved in the energy release by the biological oxidation of food inside the mitochondria and in biosynthetic and detoxification mechanisms, were investigated in a freshwater teleost, Channa punctatus (Bloch), exposed for 28 days. The C. punctatus were collected from a freshwater tributary of the Satluj River, India. Vegetable oil effluent from a facility in the Ludhiana district had a biphasic effect on the enzymes. Inhibition or stimulation of enzyme activity were dependent on dose and duration. Specific effects of the effluent on glucose-6-phosphate hydrogenase, lactate hydrogenase, glutamate hydrogenase, isocitrate hydrogenase, malate hydrogenase, and malic enzyme and the resulting effects of the enzyme activity changes on the fish are presented. (Wood-PTT)
W88-04150

HISTOPATHOLOGICAL AND BIOCHEMICAL CHANGES IN THE LIVER OF A TELEOST FISH, CHANNA PUNCTATUS (BLOCH) INDUCED BY A MERCURIAL FUNGICIDE,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
R. N. Ram, and A. G. Sathyanesan.
Environmental Pollution (Series A) EPEBD7, Vol. 47, No. 2, p 135-145, 1987. 6 fig, 1 tab, 30 ref.

Descriptors: *Fungicides, *Water pollution effects, *Fish, *Fish physiology, *Biochemistry, Organomercury compound, Mercury, Emisan, Liver, Pesticides, Pollutants, Water pollution, Tissue analysis, Toxicity.

The chronic effects of a prolonged exposure of 6 months, from January to June, to a 'safe dose' (0.20 milligrams/liter) of a commercial organomercurial fungicide, Emisan (methoxy ethyl mercuric chloride: MeEHgCl), on the histopathology of liver in adult and young (yearlings) of Channa punctatus, are described. In both of the experimental groups, liver histology exhibited various abnormalities, including hyperplasia, nuclear pyknosis, fatty necrosis, and degeneration of hepatocytes leading to tumor and syncytium formation, which are indicative of carcinogenesis. Apart from this, blood vessel congestion and edema were also observed in young treated fish. In the livers of both exposed groups, corresponding with this cellular damage, a marked reduction in hepatosomatic index, levels of total protein and lipid, and an elevation in cholesterol, acid and alkaline phosphatase contents were recorded. These alterations were more pronounced in young than in adult fish. These Emisan-induced, histopathological and biochemical changes are suggestive of severe hepatic dysfunction, which may result in the impairment of the physico-metabolic process, in this species. (Author's abstract)
W88-04154

HEALTH EFFECTS OF ACID RAIN: ARE THERE ANY,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
M. A. Benarde.
Journal of the Royal Society of Health, Vol. 107, No. 4, p 139-145, August 1987. 3 fig, 62 ref.

Descriptors: *Acid rain, *Water pollution effects, *Human physiology, *Air pollution effects, Literature review, Rainfall, Hydrogen ion concentration, Pollutants, Air pollution, Acidic water, Public health.

Rainwater usually has a pH of 5.6 or below, as a result of the reaction of rain with atmospheric carbon dioxide producing the weak acid, carbonic acid. Acidity at the 5.6 to 5.8 level is sufficient for dissolving minerals to make them available in the trace quantities necessary for plant, animal and human nutrition. Acid rain, however, is characterized by the presence of more than trace amounts of sulfur and nitrogen compounds. The literature is reviewed to determine both the direct and indirect effects of acid rain on human health by analyzing the salient scientific documents, published papers, and conference summaries. Numerous suggestions of avenues of potential direct and indirect harm which could be taken by pollutants were found, but deleterious human health effects were not confirmed. No definitive studies linking acid rain with clinically observable human ill effects were located in the literature. If harmful clinical or sub-clinical health effects exist, they remain largely unobserved and undetected. Cancer, heart disease, and other major causes of mortality were not induced or exacerbated by acid rain. If adverse health effects

are involved, they may be related to the mechanical properties of the lung, but this remains unproven. (Wood-PTT)
W88-04156

SPATIO-TEMPORAL VARIABILITY OF CHAETOZONE SETOSA (MALMGREN) POPULATIONS ON AN ORGANIC GRADIENT IN THE BAY OF BREST, FRANCE,
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
For primary bibliographic entry see Field 2L.
W88-04167

INCIDENCE OF DEFORMITIES IN CHIRONOMUS SPP. FROM PORT HOPE HARBOUR, LAKE ONTARIO,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
W. F. Warwick, J. Fitchko, P. M. McKee, D. R. Hart, and A. J. Burt.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 88-92, 1987. 1 fig, 28 ref.

Descriptors: *Water pollution effects, *Port Hope Harbor, *Lake Ontario, *Radioactive wastes, *Chironomus, Radium, Uranium, Radionuclides, Trace metals, Toxicity, Heavy metals, Water temperature, Thorium.

Chironomus spp. larvae collected from sediments in the harbor at Port Hope, Ontario in November 1984, had a greater incidence of mouth part deformities in the more heavily polluted inner harbor area (83%, 33 of 40 individuals) than in the outer harbor (14%, 1 of 7 individuals). Port Hope Harbor, the site of radium and uranium refining operations since 1933, is contaminated by 218-U and (to a lesser extent) 232-Th decay chain radionuclides and several trace metals. This difference suggests that deformities are related to the areal extent of contamination. An estimated dose rate of 1 mGy/day in chironomids suggests that radiation may be a significant factor in the induction of deformities; however, heavy metals (maximum copper concentrations in the sediment were 6,600 microgram/gm; lead and nickel were also present) and elevated water temperatures may also be involved. The usefulness of deformities in natural populations as a biomonitoring tool to evaluate sediment quality is under investigation. (Lantz-PTT)
W88-04212

ACID RAIN STIMULATION OF LAKE MICHIGAN PHYTOPLANKTON GROWTH,
Fish and Wildlife Service, Ann Arbor, MI. Great Lakes Fishery Lab.
B. A. Manny, G. L. Fahnenstiel, and W. S. Gardner.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 218-223, 1987. 3 fig, 2 tab, 17 ref.

Descriptors: *Acid rain, *Water pollution effects, *Phytoplankton, *Lake Michigan, Ecosystems, Chlorophyll a, Acidic waters, Hydrogen ion concentration, Population growth, Algae, Eutrophication.

Three laboratory experiments demonstrated that additions of rain water to epilimnetic lake water collected in southeastern Lake Michigan stimulated chlorophyll a production more than did additions of reagent-grade water during incubations of 12 to 20 d. Chlorophyll a production did not begin until 3-5 d after the rain and lake water were mixed. The stimulation caused by additions of rain acidified to pH 3.0 was greater than that caused by additions of untreated rain (pH 4.0-4.5). Results support the following hypotheses: (1) Acid rain stimulates the growth of phytoplankton in lake water; (2) phosphorus in rain appears to be the factor causing this stimulation. It is concluded that acid rain may accelerate the growth of epilimnetic phytoplankton in Lake Michigan (and other similar lakes) during stratification when other sources of bioavailable phosphorus to the epilimnion are limited. (Author's abstract)
W88-04223

WATER QUALITY AND DIATOM COMMUNITIES IN TWO CATALAN RIVERS (N.E. SPAIN),
Barcelona Univ. (Spain). Dept. de Ecologia.
S. Sabater, F. Sabater, and X. Tomas.
Water Research WATRAG, Vol. 21, No. 8, p 901-911, August 1987. 3 fig, 4 tab, 30 ref. C.A.I.C.Y.T. Project No. 478/81.

Descriptors: *Water quality, *Diatoms, *Spain, *Water pollution, *Llobregat River, *Ter River, Monitoring, Species diversity, Ecosystems.

Benthic diatom assemblages have been used to evaluate the water quality of two rivers subjected to marked human influences. These rivers, the Llobregat and the Ter, are located in N.E. Spain, and supply water for the industrial, agricultural and urban requirements of roughly three million people. The diatom communities in the headwaters are similar in both rivers (Achnanthes minutissima, Cymbella ventricosa, Gomphonema angustatum). Species of Navicula, Nizschia and Gomphonema develop in the middle reaches of both rivers when not disrupted by extraneous factors. In the river Ter significant pollution modifies this community and Nizschia palea, N. gandersheimiensis and Gomphonema parvulum appear as the most tolerant species. In the Llobregat, the pollution from the salt mine operations also modifies the diatom assemblage and N. frustulum, Surirella ovata, Navicula atomus are the most abundant species. Reservoirs in the river Ter improve the quality of water and a community of Fragilaria sp. pl. is dominant downstream. (Author's abstract)
W88-04252

EFFECTS OF A CHLORINATED DISCHARGE AND A THERMAL OUTFALL ON THE STRUCTURE AND COMPOSITION OF THE AQUATIC MACROINVERTEBRATE COMMUNITIES IN THE SHEEP RIVER, ALBERTA, CANADA,
Illinois Univ. at Urbana-Champaign. Dept. of Urban and Regional Planning.
L. L. Osborne, and R. W. Davies.
Water Research WATRAG, Vol. 21, No. 8, p 913-921, August 1987. 2 fig, 5 tab, 31 ref.

Descriptors: *Thermal pollution, *Water pollution effects, *Macroinvertebrates, *Sheep River, *Alberta, *Chlorination, Biological studies, Physicochemico properties, Chlorinated compounds, Wastewater pollution, Wastewater disposal, Ecological effects.

Physico-chemical and biological samples were collected from 12 sampling stations over a 13-month period to assess the effects of a small town's chlorinated sewage discharge and a thermal discharge on the Sheep River's macroinvertebrate communities. During the study, the chlorinated effluent plume was restricted to the left third of the channel for approximately 0.5 km at which point the effluent was thoroughly mixed due to an abrupt change in channel direction. Within the concentrated 0.5 km chlorinated plume, total residual chlorine (TRC) concentrations periodically exceeded 5.0 mg/L. Stations were categorized into similar community assemblages on the basis of species abundances and composition using hierarchical cluster analysis. Stations immediately downstream of the thermal outfall and those within the chlorinated plume had distinctly different structures and were dominated by Oligochaeta. Multiple discriminant analysis indicated that temperature was the principle discriminating variable immediately below the thermal discharge while the chlorinated sewage (MCSE) variable was the most important discriminant function within the chlorinated effluent plume. Following complete mixing of the effluent plume within the stream channel (0.6 km downstream of outfall), macroinvertebrate structure and diversity improved, presumably due to nutrient enrichment and dilution of TRC below detectable levels. (Author's abstract)
W88-04253

EFFECT OF PH ON PHOSPHORUS RELEASE DURING MACROPHYTE (ELEOCHARIS SP.) DECOMPOSITION,
Breedlove, Dennis and Associates, Orlando, FL.
R. W. Ogburn, P. L. Brezonik, and J. J. Delfino.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 829-831, October 1987. 1 fig, 1 tab, 12 ref. U.S. EPA Project APP-077-02-1980.

Descriptors: *Acid rain, *Acidic waters, *Ecological effects, *Water pollution effects, *Phosphorus cycling, *Hydrogen ion concentration, *Decomposing organic matter, Decomposition, Phosphorus, Macrophytes, Oligotrophic lakes, Florida, Lakes.

Laboratory microcosms were used to evaluate the effect of pH on the release of soluble reactive phosphorus (SRP) during aerobic decomposition of the aquatic macrophyte Eleocharis sp., which is common in oligotrophic Florida lakes. The total amount of SRP released during a 227-day incubation in the dark was independent of pH over the range 3.7 to 5.5, but initial rates of release were faster at the lowest pH. The results indicate that the low total phosphorus concentrations observed in many acidic lakes are not necessarily attributable to reduced rates of decomposition and nutrient mineralization at low pH, as some researchers have suggested. (Author's abstract)
W88-04283

WATER POLLUTION FORM OIL AND GAS RECOVERY IN EASTERN KENTUCKY WATERSHEDS,
Kentucky Div. of Air Quality, Frankfort. Program Development Branch.
A. Sidhu, and W. J. Mitsch.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 943-953, October 1987. 7 fig, 6 tab, 23 ref.

Descriptors: *Brines, *Fate of pollutants, *Water pollution effects, *Path of pollutants, *Brine disposal, *Surface water, *Kentucky, Groundwater pollution, Water quality, Industrial wastes, Oil recovery, Gas recovery, Saline water, Salinity, Watersheds, Sodium, Chlorides, Chemical analysis.

The effects of water quality on brine discharged from oil and gas recovery operations are described for surface water and groundwater in two small watersheds in eastern Kentucky. The brine, which had salinity that was often several times that of sea water, led to significantly higher concentrations of several minerals in surface water, particulary in the first and second order streams. Concentrations as high as 50,000 milligrams/liter for sodium and 64,000 milligrams/liter for chloride were measured in streams. The differences in chemical concentrations for various chemicals over the period of the study were ascribed to temporal variability, particularly due to differences between wet and dry seasons, and to spatial variability, particularly due to dilution and other chemical decay processes. Chemical decay coefficients for sodium and chloride were developed as a function of watershed area for possible application to similar watersheds. There was some evidence that the brine was influencing the Licking River, the major stream that drains the eastern part of Kentucky. (Author's abstract)
W88-04299

RADIOACTIVITY OF THE ATOMIC SPA AT PODCETRTEK, SLOVENIA, YUGOSLAVIA,
Institut Jozef Stefan, Ljubljana (Yugoslavia).
For primary bibliographic entry see Field 2F.
W88-04329

BIODEGRADATION OF SUBSTANCES AT LOW CONCENTRATIONS (BIOLOGISCHER ABBAU VON STOFFEN BEI GERINGEN KONZENTRATIONEN),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W88-04338

IMPACT PREDICTION METHOD FOR ACCIDENTAL RIVER POLLUTION,
Compagnie Generale des Eaux, Paris (France).
M. Dutang, and G. Bujon.

Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 741-756, 1987. 13 fig, 9 ref.

Descriptors: *Water pollution effects, *Water quality, *Rivers, *Model studies, Monitoring, Simulation analysis, Prediction, Mathematical models, Biodegradation, Path of pollutants.

Predicting the impact of accidental pollution is more difficult than that of continuous pollution, and describing the variability of the phenomena involved is not an easy task. A simulation method was developed using a sophisticated mathematical model which, when applied to an accidental spillage of toxic material, accurately determines its impact on water intakes downstream from the spill. The model is based on dispersal equations and makes allowances for the phenomenon of biological decay and the velocity gradient of the water in the river. It was used during simulations conducted by injecting a dye into the river. The model has been used several times since 1980 along the Seine and Marne Rivers to forecast polluting waves from accidental spells with a high degree of accuracy. The model can also be used to calculate critical pollution levels above which accidental spillage could have an adverse effect on water production, based on the distance to the water intakes and the river's most unfavorable flowrate. (Lantz-PTT)
W88-04359

POLLUTION AND EUTROPHICATION IN THE VENICE LAGOON,
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
For primary bibliographic entry see Field 6G.
W88-04365

MANAGEMENT OF SURFACE WATER QUALITY IN INDIA,
Saifia Coll., Bhopal (India). Dept. of Limnology.
For primary bibliographic entry see Field 5G.
W88-04421

ISOTOPICALLY EXCHANGEABLE PHOSPHATE IN FRESHWATER SEDIMENTS: EFFECTS OF U. V.-IRRADIATION, FORMALDEHYDE, SOLID/SOLUTION RATIO, AND PH ON ITS EXPERIMENTAL DETERMINATION,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geochemistry.
For primary bibliographic entry see Field 5B.
W88-04453

EFFECTS OF CARBARYL (SEVIN) ON THE STAGE I ZOEAE OF THE RED-JOINTED FIDDLER CRAB, UCA MINAX (LECONTE),
Roger Williams Coll., Bristol, RI. Dept. of Natural Sciences.
P. S. Capaldo.
Estuaries ESTUDO, Vol. 10, No. 2, p 132-135, June 1987. 1 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *SEVIN, *Crabs, *Eggs, Insecticides, Carbaryl, Toxicity, Lethal limits, Mortality, Physiological effects.

Carbaryl, 1-napthyl methylcarbamate (SEVIN), is a broad spectrum organocarbamate that has been widely used for the control of insect infestations. It attacks the nervous system of target organisms by lowering cholesterase levels. In 1958, carbaryl replaced DDT as the agent of choice for control of the gypsy moth, Lymantria dispar. Carbaryl was preferable primarily because of its low mammalian toxicity and its rapid degradation in the natural environment. It degrades in water to levels below detection in times ranging from six days to four weeks. Shortly after spawning, zoeae of the red-jointed fiddler crab, Uca minax, were exposed to 1.0, 0.5 and 0.1 mg/L of carbaryl. Exposed zoeae were observed for fatalities, changes in phototaxis, and altered swimming behavior. Fifty percent mortalities in these concentrations occurred after 12.5, 14.5 and 25 hr, respectively. Zoeae displayed a rapid loss of positive phototaxis, which occurred after 2, 4 and 16 hr, respectively. Abnormal swimming behavior was observed in all exposed groups, with total cessation of swimming activity occurring in 6 hours in groups I and II and 16 hours in group III. (Lantz-PTT)
W88-04481

5D. Waste Treatment Processes

DEMONSTRATION OF INDUSTRIAL WASTEWATER RENOVATION BY EXTRACTION OF ORGANIC CHEMICALS USING POROPLASTIC MEMBRANES,
Moleculon Research Corp., Cambridge, MA.
L. D. Nichols, A. S. Obermayer, M. B. Allen, and C. Cekala.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-162392/AS. Price codes: A04 in paper copy, A01 in microfiche. OWRT Technical Completion Report, RU-84/3, October 29, 1982. 44 p, 11 fig, 7 tab, 11 ref. Contract No. 14-34-0001-1470.

Descriptors: *Wastewater renovation, *Industrial wastewater, *Organic solvents, *Separation techniques, *Membrane processes, *Chemical recovery, Organic compounds, Wastewater treatment, Water reuse, Phenols, Industrial wastes, Acetic acid, Cost analysis.

Process development conducted during this study has clearly established membrane separation techniques as an effective means to remove organic chemicals from industrial wastewater streams. Rapid exchange rates observed for parachlorophenol and pentachlorophenol imply that Poroplastic membranes have a high efficiency for pentachlorophenol and parachlorophenol removal. Rapid transport indicates that relatively short space-times would provide sufficient organic removal, thus allowing large volumes of wastewater to be handled by a small number of membrane extraction units. After identifying several solvents with good acetic acid extraction characteristics, successful removal of acetic acid from artificial wastewater streams was achieved during single membrane extraction experiments. By comparing extraction rates, distribution coefficients, water content levels in the solvent, solvent content levels in the water stream, and other membrane system characteristics the most promising system was scaled-up to the multi-membrane plate and frame module. Large scale multi-membrane extractions with simulated as well as real process effluent streams resulted in an average extraction rate constant of 4.28/hr/sq m for acetic acid. When total cost of a Poroplastic membrane extraction scheme for recovering acetic acid is analyzed, it appears to be a very cost effective alternative to conventional wastewater treatment. (Geiger-PTT)
W88-03494

WATER CONSERVATION TECHNOLOGY IN TEXTILES: STATE OF THE ART.
Auburn Univ., AL. Water Resources Research Inst.
For primary bibliographic entry see Field 3E.
W88-03495

LONG-RANGE CHLORINATION IN OPEN MICROCOSMS: INTERPRETATIONS,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W88-03507

WASTEWATER TREATMENT PLANT DISINFECTION EFFICIENCY AS A FUNCTION OF CHLORINE AND AMMONIA CONTENT,
G. C. White, R. D. Beebe, V. F. Alford, and H. A. Sanders.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1115-1125, 4 fig, 4 tab, 4 ref.

Descriptors: *Wastewater treatment, *Chlorination, *Ammonia, *Disinfection, San Jose/Santa Clara Water Pollution Control Plant, California, Chloramines, Coliforms, Mixing.

The unusual chlorine demands periodically experienced at the San Jose/Santa Clara, California, wastewater treatment plant were investigated. Normal chlorine dosage sufficient for disinfection was 12 mg/L, producing a residual of 5-6 mg/L at the end of the contact chamber. During canning season the secondary effluent was very low in ammonia, and chlorine demand increased beyond the capacity of the system to disinfect it. A newly added tertiary treatment plant also produced an effluent with an unusually high chlorine demand. In laboratory studies addition of ammonia to produce a chlorine-ammonia-N ratio of 6:1 and increased mixing resulted in disinfection meeting the standard of 2.2 coliforms per 100 ml of effluent. Laboratory studies of the tertiary treatment system showed that a 12-mg/L chlorine dose and a 2-mg/L ammonia-N dose effectively disinfected the effluent to meet standards. Visits to other treatment plants confirmed that the presence or addition of ammonia improved operation of several, but not all. (Cassar-PTT)
W88-03530

HEALTH AND ENVIRONMENTAL IMPACTS OF BROMINATED ORGANICS PRODUCED DURING WASTEWATER DISINFECTION WITH BROMIDE CHLORIDE,
Dow Chemical Co., Midland, MI.
R. W. Hohlfeld, C. G. Mendoza, G. U. Boggs, and H. C. Alexander.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1127-1135, 4 tab, 14 ref.

Descriptors: *Wastewater treatment, *Literature review, *Water pollution effects, *Disinfection, Bromine chloride, Public health, Aquatic life, Toxicity, Fate of pollutants, Organic compounds, Trihalomethanes, Bromoform, Bromine compounds, Bromides.

Interpretation of all available data indicates that use of bromine chloride for water treatment does not pose any significant threat to aquatic life or human health as a result of any brominated organics that may be formed. Low levels of trihalomethanes (bromoform), which are nontoxic to aquatic life, are produced. Because bromoform degrades relatively quickly and does not bioaccumulate, it should not pose a threat to human health. Very low levels (parts per trillion) of bromoorganics, particularly bromophenols and bromoanisoles, are formed from bromine chloride water treatment. Although these bromoorganics have moderate bioaccumulation potential, they have been detected only in levels less than 100 ppb in fish exposed to bromine chloride treated water and pose no danger to human health. Bromine ion does not appear to be biotransformed by fish and microorganisms into bromoorganics. (Author's abstract)
W88-03531

HEALTH EFFECTS OF WATER REUSE: CHARACTERIZATION OF MUTAGENIC RESIDUES ISOLATED FROM RECLAIMED, SURFACE, AND GROUNDWATER SUPPLIES,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5A.
W88-03540

CHLORINE VS OZONE AT MARLBOROUGH, MASSACHUSETTS: DISINFECTION AND MUTAGENIC ACTIVITY SCREENING,
Oklahoma State Univ., Stillwater.
E. L. Stover, R. B. Cumming, N. E. Lee, and R. L. Jolley.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1249-1260, 7 fig, 4 tab, 6 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Mutagens, *Disinfection, Chlorination, Ozonation, Organic compounds.

Screening for mutagenic activity of concentrated wastewater effluents (primarily of domestic origin) and for selected components separated by liquid chromatography was conducted before disinfection and on ozonated and chlorinated effluents. A 2000-fold concentrate of the undisinfected effluent was mutagenic in both TA1535 and TA1538. No mutagenic activity was detected in the 2000-fold concentrates of either the ozonated or chlorinated effluents at doses of 10.9 and 3.0 mg/L, respectively. Of 31 pooled fractions of the undisinfected effluent, only one was slightly positive in TA1538. Of 16 fractions of ozonated effluent (ozone dose, 17.7 mg/L) 4 were positive and 1 was slightly positive in both strains. Of 24 fractions of chlorinated effluent (chlorine dose, 7.0 mg/L) 2 were positive. Although ozonation and chlorination apparently destroyed mutagenic components (eluting before 10.5 hr) in the effluent, chlorination produced several mutagenic constituents with chromatographic retention times between 1 and 6 hours. Three mutagenic materials were common to both undisinfected effluent and chlorinated effluent. The nature of the mutagens in fraction 151-175 changed from mutagenic to TA1535 in the undisinfected effluent to mutagenic to TA1538 in the chlorinated effluent. Higher doses of chlorine appeared to increase the mutagenic activity. (Cassar-PTT)
W88-03541

EVALUATION OF THE QUALITY OF WASTEWATER TREATMENT EFFLUENT FOLLOWING CHLORINATION OR OZONATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
C. L. Fort, M. K. Koczwara, E. J. Kirsch, and C. P. Grady.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1261-1278, 3 fig, 4 tab, 14 ref.

Descriptors: *Wastewater treatment, *Disinfection, *Mutagens, *Chlorination, *Ozonation, Fate of pollutants, Activated sludge process, Biological wastewater treatment, Organic compounds, Toxicity.

Bench-scale activated sludge reactors were operated, representing all combinations of two levels of each of the following variables: simple and complex organic feed mixtures; pH, 6 and 8; and dissolved oxygen, 1 and 7 mg/L. Breakpoint chlorination curves were developed to determine the dose that would produce a chlorine residual of 5-10 mg/L after 2 hrs of contact. Curves were also developed to show the ozone dose required to give a residual of 0.4 mg/L after 5-min contact. Effluent samples were concentrated and assayed for mutagenicity corrected for toxicity. Several conclusions were made. (1) The microorganisms in activated sludge release toxic or mutagenic substances, regardless of the complexity of the wastewater. The concentration or activity of these substances depends on the conditions imposed. (2) Breakpoint chlorination of effluents generally increases their toxicity or mutagenicity; however, prior growth conditions influence the composition of the organics and the susceptibility of the organics to reaction with chlorine. (3) Ozonation increases the toxicity or mutagenicity of effluents as shown by TA98 but not by TA100. (4) Chlorine can be incorporated into the organic fraction of the effluents during breakpoint chlorination, the amount being influenced by growth conditions in the reactor. (5) The toxicity and mutagenicity of chlorinated effluents cannot be correlated with the amount of incorporated chlorine. (Cassar-PTT)
W88-03542

MUTAGENICITY OF NONVOLATILE ORGANICS IN UNDISINFECTED AND DISINFECTED WASTEWATER EFFLUENTS,
Oak Ridge National Lab., TN.
R. B. Cumming, R. L. Jolley, N. E. Lee, L. R. Lewis, and J. E. Thompson.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. pg 1279-1309, 6 fig, 11 tab, 18 ref.

Descriptors: *Wastewater treatment, *Disinfection, *Mutagens, *Chlorination, *Ozonation, Activated sludge process, Biological wastewater treatment, Organic compounds, Fate of pollutants, Toxicity, Ultraviolet radiation, Public health.

Additional data on the effect of disinfection methods on mutagenicity of wastewater effluents is reported. Although treatment plants differ from each other and from day to day, some generalizations are possible. Either chlorine or ozone sometimes increases or decreases the mutagenicity of the effluents. No conclusions can be made concerning the effect of ultraviolet treatment. Mutagenicity is increased by disinfection in more cases than it is decreased. In general, more total mutagenicity is seen in samples pooled from high-performance liquid chromatography fractions than in original concentrates from which they are derived. Although some chemicals have been identified in the mutagenic fractions, they are not known mutagens. Although mutagens can be formed in the disinfection process, they are often destroyed as the concentration or contact time increases. Thus, results are very dependent on the precise conditions at the time of sampling; they can be dramatically affected by differences in the raw effluent, weather, or conditions of disinfections. (Cassar-PTT)
W88-03543

REDUCTION OF MICROBIAL INDICATORS AND VIRUSES IN A CYPRESS STRAND,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. R. Scheuerman, S. R. Farrah, and G. Bitton.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 1-8, 1986. 2 fig, 4 tab, 18 ref. EPA Grant R809402.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Wastewater disposal, *Biodegradation, Microorganisms, Bacteria, Viruses, Sewage bacteria, Coliforms.

Wetlands have been proposed for the low-energy treatment and disposal of wastewater treatment plant effluents. In general, an improvement in bacteriological water quality has been observed following the passage of sewage effluent through wetland systems. This study examined the fate of microbial indicators and pathogens, including viruses, in a cypress stand that has been receiving effluents from the town of Waldo, Florida, for the last 50 years. Experimental corridors (40m x 10m) were installed in a strand and were treated with pumped primary effluent. Bacterial indicators (total and fecal coliforms, fecal streptococci), bacteriophages and enteroviruses were removed following 40m travel of sewage through the corridors. Fecal streptococci accumulate in the sediments. The levels of bacterial indicators, phages and enteroviruses were monitored in another strand that had been receiving sewage for 50 years. Microbial numbers were determined at stations situated at increasing distances from the sewage outfall, up to 230m. Bacterial indicators were reduced by approximately 3 orders of magnitude at the 230m station. Fecal streptococci accumulated in the sediments. Phages were reduced by 1 order of magnitude. Enteroviruses and Salmonella species were detected in the water but often were undetectable in the sediments. (Author's abstract)
W88-03559

SURVIVAL OF INDICATOR ORGANISMS IN A DETENTION POND RECEIVING COMBINED SEWER OVERFLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5B.
W88-03560

DISINFECTION EFFICIENCY AND PROBLEMS ASSOCIATED WITH MATURATION PONDS,
State Pollution Control Commission, Lidcombe (Australia).
R. J. Macdonald, and A. Ernst.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 19-29, 1986. 3 fig, 3 tab, 11 ref.

Descriptors: *Wastewater disposal, *Fate of pollutants, *Stabilization ponds, *Wastewater treatment, *Disinfection, Human diseases, Viruses, Microorganisms, Parasites, Maturation ponds.

Disinfection is the destruction, inactivation or removal of those organisms likely to cause infection; it does not necessarily involve sterilization. In Australia, chlorination and/or maturation ponds are the methods frequently used to improve the microbiological quality of treated sewage effluents before discharge to receiving waters or reuse. Reductions in densities of indicator organisms and pathogens were measured in maturation ponds receiving secondary effluents from trickling filter and activated sludge treatment works. Effluent detention times in the ponds were determined using dye tracing techniques and compared with nominal detention times calculated from pond volumes and effluent flow rates. Median detention times were substantially less than nominal times because of short circuiting due to pond design aspects and thermal stratification. Maturation ponds of 10 days median detention time were found to successfully disinfect a poor quality trickling filter effluent and were effective at removing parasite ova and reducing virus densities. Continued use of maturation ponds should be encouraged in developed and developing countries as they have low cost, operational, maintenance and skilled operator requirements and are an effective disinfection process. Pond designs should minimize short circuiting and thus the areal requirements of the ponds. (Authors' abstract)
W88-03561

REMOVAL OF EXCRETED BACTERIA AND VIRUSES IN DEEP WASTE STABILIZATION PONDS IN NORTHEAST BRAZIL,
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, T. P. Curtis, S. A. Silva, and D. D. Mara.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 31-35, 1986. 1 fig, 2 tab, 16 ref.

Descriptors: *Wastewater disposal, *Fate of pollutants, *Wastewater treatment, *Stabilization ponds, Bacteria, Viruses, Microorganisms, Public health.

Waste stabilization ponds are becoming an increasingly popular wastewater treatment option in many parts of the world. Their advantages include low cost, minimum maintenance, and high degree of excreted pathogen removal. Their principal disadvantage is their long hydraulic retention time, measured in weeks, which requires a large land area. Typical depths of facultative and maturation ponds range 0.9-1.5m to restrict growth of emergent vegetation and maintain predominantly aerobic conditions. This study examined the removal of excreted bacteria (fecal coliforms, fecal streptococci, Clostridium perfringens, total and sorbitol-fermenting bifidobacteria, salmonellae, and thermophilic campylobacters) and viruses (enterovirus and rotavirus) in a series of deep anaerobic, facultative and maturation ponds with a depth range of 2.8-3.4m, overall retention time of 21 days, and mean mid-depth temperature of 27 C. Thermophilic campylobacters, bifidobacteria and salmonellae were not detected after 11, 16 and 21 days retention, respectively. Fecal coliformes, fecal streptococci, and Clostridium perfringens were reduced 4, 4, and 2 orders of magnitude, respectively, and enteroviruses and rotaviruses both by 3 orders. Pathogen removal in deep ponds is similar to that in ponds of normal depth. Deep ponds could result in significant land savings and permit use in high density metropolitan areas. (Authors' abstract)
W88-03562

EFFECT OF SUNLIGHT ON COLIPHAGES IN AN OXIDATION POND,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
S. Ohgaki, A. Ketratanakul, and U. Prasertsom.
Water Science and Technology WSTED4, Vol.

18, No. 10, p 37-46, 1986. 9 fig, 1 tab, 14 ref.

Descriptors: *Wastewater disposal, *Fate of pollutants, *Wastewater treatment, *Bacteriophages, *Oxidation ponds, Microorganisms, Viruses, Coliforms.

An understanding of the inactivation process or survival mechanism of enteric viruses in natural waters and in water/wastewater treatment plants is necessary for preventing waterborne diseases caused by pathogenic viruses. Escherichia coli B were used as host cells for isolation and multiplication of coliphages. The coliphages were isolated from a small canal which receives the effluent from an oxidation pond in Bangkok, Thailand, and were used as a virological indicator. Batch experiments showed that adsorption of coliphage to microbial particulates (mainly algae) occurred under aerobic conditions; desorption was observed under anaerobic conditions. The adsorption-desorption process was reversible and was controlled by dissolved oxygen concentration. The same mechanism of adsorption-desorption was observed in the oxidation pond as well. During daytime, the concentration of coliphage decreased under high concentration of dissolved oxygen caused by photosynthesis. After sunset, the concentration of coliphage increased because the dissolved oxygen concentration in the pond decreased to zero due to respiration of algae. The degree of removal of coliphage in the oxidation pond (design retention time 20 days) was 90% (1 log). Field measurement with submerged bottles in the oxidation pond and sunlight-exposure experiment using beakers showed that coliphage could be inactivated by sunlight only near the water surface (<10cm depth) in the oxidation pond. (Authors' abstract)
W88-03563

FATE OF HUMAN ENTERIC VIRUSES (ROTAVIRUSES AND ENTEROVIRUSES) IN SEWAGE AFTER PRIMARY SEDIMENTATION,
Barcelona Univ. (Spain). Dept. of Microbiology.
A. Bosch, F. Lucena, and J. Jofre.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 47-52, 1986. 4 tab, 15 ref.

Descriptors: *Fate of pollutants, *Coagulation, *Wastewater Treatment, *Enteroviruses, Viruses, Public health, Microorganisms, Wastewater disposal.

The inadequacy of wastewater treatment process in effectively removing viruses from sewage has led to concern to the levels of wastewater effluent being discharged into the environment. Viruses readily adsorb onto solid particles present in sewage and aggregate in sludges. The removal of solid matter from a contaminated source leads to a reduction of virus levels in the sewage effluent. Viruses associated with solids tend to survive for longer periods than viruses in a dispersed phase. A wastewater treatment plant, which treats sewage by either mechanical primary sedimentation or lime coagulation, was used to model the fate of human enteric viruses after these treatments. The occurrence of human rotaviruses and enteroviruses was monitored in sewage effluent, effluent, and sludge samples. The level of indigenous enteric viruses in raw sewage was very high (up to 10,000 I.U. per liter). The values of rotavirus and enterovirus were of the same magnitude but no correlation was found between the levels of both kinds of human enteric viruses. Both rotaviruses and enteroviruses were removed from sewage and transferred to sludge at similar rates after mechanical sedimentation, although rotaviruses were more efficiently recovered from sludge samples than enteroviruses. After chemical coagulation by lime treatment, most human enteric viruses in sludge were inactivated. Lime coagulation should be regarded as a most effective single-step treatment for the removal of such viral pathogens from sewage. (Authors' abstract)
W88-03564

EVALUATION OF TERTIARY TREATMENT SYSTEMS FOR WASTEWATER RECLAMATION AND REUSE,
Engineering-Science, Inc., Berkeley, CA.
W. R. Kirkpatrick, and T. Asano.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 83-95, 1986. 5 fig, 6 tab, 12 ref.

Descriptors: *Tertiary wastewater treatment, *Wastewater treatment, *Microorganisms, Pathogenic bacteria, Pathogens, Viruses.

Bacterial pathogens and viruses are removed in varying degrees by tertiary or advanced wastewater treatment. Principal treatment processes and operations for producing reclaimed water that has an extremely low probability of virus or bacterial contamination normally include chemical coaggulation followed by flocculation, sedimentation, filtration, and disinfection. Alternatively, direct filtration with lower chemical doses and without sedimentation is often used. However, optimization of the chemical coagulation and filtration of secondary effluent has been difficult to achieve in practice and has hampered the establishment of alternative and more cost-effective wastewater reclamation methods. Based on the Monterey Wastewater Reclamation Study for Agriculture recently completed in Castroville, California, pertinent data are used to assess design and operational variables in an attempt to optimize the performance criteria of the two tertiary treatment trains. (Authors' abstract)
W88-03569

COMPARATIVE DISINFECTION OF INDICATOR BACTERIA AND POLIOVIRUS BY CHLORINE DIOXIDE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, M. A. Dow, and B. S. Yoneyama.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 125-132, 1986. 5 fig, 1 tab, 7 ref.

Descriptors: *Disinfection, *Water treatment, *Wastewater treatment, *Chlorination, Microorganisms, Bacteria, Viruses.

Chlorine continues to be the disinfectant of choice to treat both drinking water and wastewaters. Chlorine can result in the formation of toxic, as well as potentially carcinogenic, products and is ineffective in disinfecting human enteric viruses. An alternative disinfectant, safer and more effective than chlorine, is being sought. Chlorine dioxide (ClO_2) is one of the most promising because: (1) it does not react with hydrocarbons to form carcinogens; (2) it remains an effective disinfectant at wide ranges of pH and in the presence of ammonia and organics in the water; and (3) it maintains a residual in the water. This study determined the effectiveness of ClO_2 to disinfect poliovirus and indicator bacteria in clean water and sewage. Clostridium perfringens was the most resistant to disinfection by ClO_2, followed by poliovirus, Streptococcus faecalis, and E. coli. These results suggest that reduction in concentrations of C. perfringens, but not fecal coliform or fecal streptococcus, can be used as a simple monitoring assay to determine if ClO_2 treatment conditions to disinfect human enteric viruses have been achieved. In sewage effluent a small and variable fraction of fecal coliform and fecal streptococcus were highly resistant to disinfection by ClO_2 and often persisted longer than the measurable levels of poliovirus. This resistant fraction of indicator bacteria was determined to be associated with the particulate matter which protected the bacteria from disinfection. (Authors' abstract)
W88-03573

VIRUS ADSORPTION TO MICROPOROUS FILTERS MODIFIED BY IN SITU PRECIPITATION OF METALLIC SALTS,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W88-03575

STUDIES OF PROCEDURES FOR RECOVERY OF VIRUSES FROM ACTIVATED SLUDGE,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
For primary bibliographic entry see Field 5A.
W88-03576

EVALUATION OF BACTEROIDES FRAGILIS BACTERIOPHAGES AS INDICATORS OF THE VIROLOGICAL QUALITY OF WATER,
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W88-03578

MICROBIAL INDICATORS FOR THE EFFICIENCY OF DISINFECTION PROCESSES,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5A.
W88-03579

CASE STUDIES IN CO-COMPOSTING, BY E. EPSTEIN.
For primary bibliographic entry see Field 5E.
W88-03594

ASSESSING RISK OF SOLID WASTE COMPOST,
Wisconsin Univ.-Stevens Point.
For primary bibliographic entry see Field 5C.
W88-03595

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART III-OXYGEN, MOISTURE, ORDOR, PATHOGENS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological Sciences.
M. S. Finstein, F. C. Miller, J. A. Hogan, and P. F. Strom.
BioCycle BCYCDK, Vol. 24, No. 3, p 38-44, March 1987. 3 tab, 26 ref.

Descriptors: *Administrative agencies, *Composting, *Sludge disposal, *Oxygen, *Odors, *Pathogens, *Regulations, *Temperature control, *Moisture, *Legal aspects, Physical properties, Ventilation, Sampling, Sanitation, Fungi.

EPA guidance on composting sludge, which leads to excessively high, biologically debilitating temperatures, has been shown to be counter productive in the area of oxygenation, moisture content and odor. The presence of oxygen is a necessary but not sufficient condition for effective composting. Its measured value is an overestimate of its availability to microorganisms especially at high temperatures. Excessive temperatures promoted by the EPA guidance suppress heat generation which limits the vaporization of water. Due to inadequate oxygenation and low activity of temperature-debilitated microorganisms, serious odor problems result. All of these problems are resolvable through maintenance of temperatures below 60 C through forced pressure ventilation with temperature feedback control. In regards to sanitation, EPA guidance is only effective in the rapid destruction of pathogens. The growth of pathogenic fungi or regrowth of other pathogens in the unstablized material is uncontrolled. This limited objective could be better achieved by a high temperature terminal or curing stage. A reduction corresponding to 25 orders of magnitude of f2 bacteriophage, rather than the 15 presently recommended, is possible with this improved approach. (Main-PTT)
W88-03596

PLANT EXPANSION PRODUCES SUPERB EFFLUENT AND MORE CAPACITY,
Bogert (Clinton) Associates, Fort Lee, NJ.
A. F. Weland, and R. G. Sobeck.
Public Works PUWOAH, Vol. 118, No. 5, p 63-65, May 1987. 1 fig.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Economic aspects, *Clarified wastewater, *Aerobic digestion, *Long-term planning, Regional planning, Rehabilitation, Effluents, Financing, Aeration, Clarification, Chlorination,

Sludge, Biochemical oxygen demand, Solids, Nitrogen, Activated sludge, Sulfur compounds.

The Raritan Township Municipal Utilities Authority (RTMUA) in New Jersey recently completed improvements to its wastewater treatment facilities that exemplify how a small treatment plant can be rehabilitated, constructed, and operated at optimum efficiency for minimum dollars. Previously the conventional activated sludge processing facility had a 1.6 mgd capacity. The RTMUA facility has since been expanded to 2.7 mgd and is projected to operate at 3.8 mgd in the future. Flexibility and future planning have been key elements in all RTMUA's expansion decisions. The facility will not have to build any aeration tanks to reach 3.8 mgd because once the regional resource recovery facility is on-line, RTMUA can eliminate its aerobic digesters and convert them to aeration tanks. The RTMUA has been able to complete improvements without a grant or creative funding. The RTMUA charged developers and commercial entities, for whom the facility was being expanded, 25% deposit to reserve capacity. The Facility Plan proposed wastewater facilities with the dual objectives of achieving economy and being able to handle projected development. Results of expansion have culminated in an effluent that has surpassed all operational expectations. The final cost of the project was $1.97 million. (Main-PTT)
W88-03598

STEEP SLOPE SEWER CONSTRUCTION CRITERIA,
For primary bibliographic entry see Field 8A.
W88-03599

ELECTRONICS EASES MANAGEMENT OF WASTEWATER COLLECTION SYSTEM,
Camp, Dresser and McKee, Inc., Boston, MA.
J. S. Kontor, and J. W. Sarver.
Water Engineering and Management, Vol. 134, No. 4, p 24-26, April 1987.

Descriptors: *Wastewater collection, *Monitoring, *Maintenance, *Automation, *Sewage systems, *Operating policies, *Computers, *Electronic equipment, Sensors, Radio waves, Economic aspects, Management planning, Remote control, Telemetry.

Instantaneous reporting of lift station operations and failures was made possible with a computer-based radio telemetry system designed by Bonston based Camp Dresser and McKee Inc. Expected benefits include better service to system customers, reductions on staff-travel time, and assistance in maintenance of the system. Computer reports of various other operations, such as maintenance records, would help the city discover which stations had frequent failures and which were overloaded and needed upgrading or expansion. Total capacity of the collection system, current and projected service areas, an alarm monitoring program, an operator's control console program, backup capability for manual operation, and a report generation package were parameters included in the new computer-based system. Field tested modular soft water packages were chosen for database generation, remote telemetry unit monitoring, collection, analysis, storage, preparation, and printing and display of operating information. The central telemetry system chosen included a DECPDP 11/83 computer with a 4-megabyte memory, peripheral equipment. Benefits of the computerized system will continue to accrue because the system can grow and help the city to do the same. (Main-PTT)
W88-03602

MOUNT HOLLY MAKES A BUSINESS OUT OF SLUDGE PROCESSING,
Mount Holly Sewerage Authority, NJ.
For primary bibliographic entry see Field 5E.
W88-03603

WATER OVERVIEW,
S. C. Agnew.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 82, p 381-396, April 1987. 8 fig, 1 tab, 7 ref.

Descriptors: *United Kingdom, *Sewer systems, *Wastewater treatment, *Water supply, *Environment, *Water use, *Planning, *Rehabilitation, *Water demand, *Policy making, *Economic aspects, Water pollution control, Engineering, Drinking water, Environmental policy, Investment, *Legal aspects, Water costs.

Sewerage and sewage treatment has so far always been seen as a public service provided by local authorities or public boards. The basic statutory requirements placed on water and drainage authorities are to provide a wholesome and adequate supply of water in pipes for domestic and other purposes and to provide for the effectual removal of sewage and surface water within their statutory areas. Water demand in the UK may be approaching a plateau. Actual per capita consumption is approximately 130 liters per head per day. There is little likelihood of any major new reservoirs being required, and the overall level of capital investment on resource development which has been declining is likely to remain low. Water authorities must continuously review their resources against changing forecast of demand. Substantial parts of the sewerage system and some sewage treatment works are now in need of renovation or replacement. Such works will continue to demand considerable attention. Much useful work has been done to obtain an objective appraisal, and a useful start has been made on the path to preservation and improvement of UK's valuable infrastructure while at the same time considering financial constraints. (Main-PTT)
W88-03609

UNIQUE SHORING EQUIPMENT INCREASES TRENCH SAFETY,
Addison Water Pollution Control Dept., IL.
G. J. Brunst.
Public Works PUWOAH, Vol. 118, No. 4, p 46, April 1987.

Descriptors: *Wastewater treatment facilities, *Civil engineering, *Excavation, *Trench safety box, Pipelines, Interceptor sewers, Economic aspects, Hydraulics, Safety.

A wastewater facilities expansion in Addison, Illinois included the installation of a 36-in reinforced concrete interceptor sewer 22 ft deep in a right-of-way 30 ft wide. Safety during excavation was a concern, and the Orfei Walking Box was chosen to ensure worker protection from trench collapse. The walking box is atypical because it hydraulically exerts up to 2,000 pounds per sq ft against the trench walls, and it is self-propelled. With the walking box the side walls of the trench can be vertical, not sloped, and remain perfectly safe because of the pressure exerted on them. Also, excavation and backfill can be reduced. Additional savings can be realized in paving restoration, sod replacement and trucking of spoils. (Main-PTT)
W88-03632

MODEL TEST OF A PUMPING STATION WET WELL,
MacLaren Plansearch, Inc., Toronto (Ontario).
L. J. D. Alexander, and G. A. Aldworth.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 24-32, 1987. 8 fig, 1 tab, 16 ref.

Descriptors: *Seewage pumps, *Wastewater treatment facilities, *Ontario, *Wastewater, Sewer systems, Sumps, Pumps.

A case study describes the model test of a wet well in an existing sewage pumping station at the Regional Municipality of Ottawa-Carleton Green Pollution Control Centre in Ottawa, Ontario. The purpose of the test was to determine whether the existing sump could accomodate projected flow increases of up to 83% associated with the proposed expansion of the plant. It was anticipated that the flow increases could cause the formation of localized flow disturbances such as vortices and eddies, which might induce unacceptable cavitation and vibrations in the proposed new larger pumps. The sump model was constructed entirely of Plexiglas to facilitate flow visualization enhanced by a dye tracer. Of particular interest was the use of a laser Doppler anemometer to measure velocity distributions at critical locations such as the pump intakes. This provided a significant improvement in accuracy and convenience over velocity-recording devices such as a pitot tube or hot wire anemometer. The methodology and considerations in the selection of the model scale are described. (Author's abstract)
W88-03640

SWEDISH FIELD EXPERIENCES WITH CHEMICAL PRECIPITATION IN STABILIZATION PONDS,
Luleaa Univ. (Sweden).
J. Hanaeus.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, p 33-40, 1987. 10 fig, 8 tab, 19 ref.

Descriptors: Descriptors:*Waste disposal, *Water pollution, *Sweden, *Wastewater, Wastewater treatment, Stabilization ponds, Phosphorus removal, Sludge.

Historically, sewage treatment in Sweden shows a trend towards the construction and use of package plants. These package plants, however, present several problems associated with flow and temperature. Year-long studies of chemical precipitation using slaked lime in stabilization ponds have demonstrated an overall reduction of organic matter of about 75% to a level somewhat below 100mg/L, and a reduction of total phosphorous of 90% to approximately 0.7mg/L as P. These values were reached under ordinary operating plant conditions. No efforts to optimize the process were made. Chemical precipitation treatment using slaked lime has shown good bacterial reduction at the high pH values obtained. Two tracer studies using Rhodamine B dye have demonstrated the appearance of strong shortcircuiting flows in pond systems and the inserting of simple baffle walls in the pond has been recommended. Dewatering the sludge in the ponds by natural freezing has proven to be an excellent process, as the time for collecting sludge can be chosen almost arbitrarily during the year. The lack of design guidlines, especially with respect to detention time, is rather obvious. The conventially used design criteria for pond surface area design have proven to be inadequate. (Author's abstract)
W88-03641

STORMWATER POLLUTION MODELLING: MINOR SOURCES OF POLLUTANTS IN URBAN SEWER NETWORKS,
P.E.S. Engineering Coll., Mandya (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-03645

REDUCTIVE METABOLISM OF AMINOAZOBENZENES BY PSEUDOMONAS CEPACIA,
Gifu Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-03699

OXIDATIVE PATHWAY AFTER REDUCTION OF P-AMINOBENZENE BY PSEUDOMONAS CEPACIA,
Gifu Univ. (Japan). Dept. of Chemistry.
E. Idaka, T. Ogawa, and H. Horitsu.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No.1, p 108-113, July 1987. 3 fig, 6 ref.

Descriptors: *Fate of pollutants, *Oxidation, *Reduction, *Metabolism, *Dyes, *Biodegradation, Dye industry wastes, Bacteria, Pseudomonas cepacia.

Metabolsim of p-aminobenzene by the microbe 13NA was studied study was to determine if this microbe can be used as a primary treatment of the effluents from dye manufacturing facilities. It was observed that reduction of the azo bond, acetyla-

tion of the resulting amines and the continued hydroxylation of the aromatic ring took place. The isolation of 3, 4-dihydroxyacetanilide when either aniline or p-phenylene-diamine was used as the substrate, indicated that dihydroxylation was caused with p-aminophenol as direct intermediate. (Ray-PTT)
W88-03700

PRESENT STATE AND FUTURE DIRECTION OF COUNTERMEASURES FOR POLLUTION FROM DOMESTIC WASTEWATER IN JAPAN,
Environment Agency, Tokyo (Japan). Water Pollution Control Div.
M. Fujiwara.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 1-8, 1986. 4 fig, 4 tab.

Descriptors: *Pollution control, *Water pollution control, *Wastewater treatment, *Wastewater disposal, *Water pollution control, *Japan, *Domestic wastes, Wastewater, Municipal wastewater, Sanitary wastewater, Raw wastewater.

Japan is poorly provided with sewerage facilities, especially in non-urban areas. When domestic wastewater is not discharged into the sewage system, only night soil is treated before discharge. The remaining domestic wastewater (grey water) is discharged untreated into public water bodies. The proportion of domestic wastewater, especially grey water, is increasing in the current water pollution load. It is unclear who is legally responsible for grey water, and there is little interest in treatment of grey water. Thus the development of domestic wastewater pollution countermeasures will be an important task. This paper classifies the systems popularly used in Japan to treat domestic wastewater, and describes the administrative regulations and Government assistance relating to them. Some promising systems for the treatment of domestic wastewater are presented and future policies on domestic wastewater pollution countermeasures are discussed. (Author's abstract)
W88-03702

TREATMENT AND REUSE OF HUMAN WASTES, AND THE PRESENT STATE OF WATER RESOURCES, IN CHINA,
Chinese Society of Environmental Science, Beijing (China).
Z. Zhongjie.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 9-12, 1986. 1 tab.

Descriptors: *Pollution control, *Water pollution control, *Domestic wastes, *Recycling, *Waste recovery, *Water pollution sources, *China, *Solid waste disposal, Solid wastes, Wastewater treatment, Wastewater disposal, Municipal wastewater.

In 1981, 73 million tons of human fecal matter and 73 million tons of solid waste were generated in large and medium size cities in China. Forty million tons were transported to rural areas as fertilizer, with only 3.9% of this treated; 70-80 million tons were used as landfill or disposed of without treatment. The level of reuse of solid waste in Shanghai, population 12-13 million, is highest among the large cities of China due to an integrated system of collection, treatment and reuse. About 3.2 million tons of fecal matter annually is collected, stored and transported to rural areas by truck, tractor and boat daily. Inorganic solid wastes are recycled to brick and glass manufacturers, etc. Landfills are reclaiming low lying areas. Some 800 million people live in rural areas where 150 million tons of human fecal matter, and 1.29 billion tons of animal fecal matter, are produced each year, increasing about 5% per year. The reuse rate for this material is 60-70%. Fecal matter and crop residues undergo low temperature fermentation or are placed into methane ponds to make fertilizer. Runoff and self-purification in the Yangtze River have maintained water quality despite industrial wastewater and sewage discharge. In drier northern China rivers near many cities have been turned into sewage channels. Nationally, only 15% of discharged sewage has been treated. A common problem near cities is the industrial pollution of groundwater and surface waters. Industrial water consumption is still inefficient. The utilization coefficient for agricultural irrigation is 20-30%. (McFarlane-PTT)
W88-03703

NIGHT SOIL TREATMENT IN KOREA,
Yeungnam Univ., Gyeongbug (Republic of Korea). Dept. of Urban Engineering.
W. T. Um, and S. W. Kim.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 13-22, 1986. 5 fig, 8 tab, 7 ref.

Descriptors: *Pollution control, *Water pollution control, *Waste treatment, *Korea, *Waste disposal, Solid waste disposal, Solid wastes, Primary treatment, Secondary treatment.

In Korea, night soil is treated in private night soil purification tanks, collected night soil treatment plants, and as farmyard manure. The systems of night soil disposal, and processes, development and performance of night soil treatment plants with their technical operational problems, are reviewed and analysed to assist in implementation and technical improvement of night soil treatment plants. A great number of night soil treatment plants in Korea have aerobic or anaerobic digestion for primary treatment, and an activated sludge process for secondary treatment. Rural night soil treatment plants are small scale with an average capacity of 18.5 cu m/day per plant. The number of toilets collected from is decreasing slightly, but sludge production from private night soil purification tanks is increasing. Therefore, development and extension of night soil treatment plants are very important at present. In many cases, strict control and upgrading of the quality of effluent from collected night soil treatment plants are mandatory. Low-energy systems and reduced-manpower programs for night soil treatment plants are to be studied and developed as much as possible. (Authors' abstract)
W88-03704

DOMESTIC WASTEWATER TREATMENT AND DISPOSAL IN THE PHILIPPINES,
E. A. R. Ouano.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 23-32, 1986. 1 fig, 8 ref, 1 append.

Descriptors: *Pollution control, *Water pollution control, *Wastewater treatment, *Phillipines, *Domestic wastes, Wastewater pollution, Wastewater disposal, Solid waste disposal, Solid wastes.

Sewage collection, treatment and disposal are often secondary functions to government agencies involved in housing, water supply, public health, solid waste management, flood control, etc. This results in proliferation of agencies with their own individual programs, policies, and objectives. This paper briefly reviews the current programs and main functions of the major government agencies involved. The paper also summarizes some of the common problems encountered in practice, especially in transfer of technology to an area with a different social cultural background. The development of the waterless toilet for both rural and urban communities is important for the effective collection, treatment and disposal of human wastes, due to the high cost of constructing sewerage and sewage treatment systems. Socio-cultural factors must be considered in the technical design, otherwise a design based exclusively on scientific facts is bound to fail due to user resistance. The growth of conventional sewerage and sewage treatment facilities will be limited to areas of high land values and high waste generation rates, such as prime commercial areas and high rise residential areas. (Author's abstract)
W88-03705

TOWARD AN AFFORDABLE HUMAN WASTE MANAGEMENT PROGRAMME FOR THE POOR - A REPORT ON BANGLADESH,
Department of Public Health Engineering, Dacca (Bangladesh).
K. M. Minnatullah.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 33-40, 1986. 2 tab, 10 ref.

Descriptors: *Pollution control, *Water pollution control, *Solid waste disposal, *Bangaladesh, *Waste disposal, Domestic wastes, Water supply, Water supply development, Public health.

Nearly 80% of all illness in Bangladesh is related to water and sanitation. The combined rate of enteric diseases is the highest in the world, with 30% of all the deaths of children under 5 due to diarrhea, claiming more than 200,000 lives annually. Environmentally sound human waste management, along with personal hygiene awareness, are of critical importance to the prevention of fecal-oral disease transmission. Present rural sanitation coverage is about 3%. A national target has been set to ensure that 13% of the rural poor will be covered under the human waste management program by 1990, the end of the U.N. Water Decade. This, however, contrasts with the similar target of 77% for the rural water supply program, which received higher resource allocation and priority for a much longer period. This lack of correlation between water and sanitation has highly reduced the positive health impact of these developments. An affordable human waste management program for the rural people, where 87% of the total population lives under conditions of the greatest poverty and underdevelopment, urgently needs serious and realistic consideration in the context of the limited resource prospects for future years. This report addresses the above issues and describes the commendable momentum that has been gained throught the continuous efforts of national planners and policy makers. It is hoped that this might in the near future, through the rural human waste management program, produce the long desired continual reduction of fecal-oral disease transmission. (Author's abstract)
W88-03706

MANAGEMENT OF HOUSEHOLD HUMAN WASTE IN JAPAN,
Ministry of Health and Welfare, Tokyo (Japan).
S. Kato.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 41-49, 1986. 4 fig, 5 tab.

Descriptors: *Pollution control, *Water pollution control, *Domestic wastes, *Solid wastes, *Japan, *Waste disposal, Solid waste disposal, Land disposal, Industrial wastes.

The present status and recent progress of Japan's waste management are reviewed. The current Waste Disposal and Public Cleansing Law is first discussed to provide the general framework of waste management. Relevant data on generation, collection and disposal are given in both tables and figures for both municipal solid waste and night soil. Latest new legislation authorizing local authorities to construct large-scale offshore land reclamation projects in the near future are summarized. After about 15 years of enforcement of the current Waste Disposal Law, the basic framework of waste management, i.e. domestic waste managed by the municipal authority and industrial waste managed with public guidance and supervision, has been well set in place. Under the law, the National Government, with the Ministry of Health and Welfare as the leading agency, has made a constant coordinated effort to assist the local government both financially and technically. In particular, the Ministry's subsidy to municipalities to construct municipal solid waste and night soil treatment plants is playing a very important role to promote rational treatment of waste. (Author's abstract)
W88-03707

SANITATION PROGRAM DEVELOPMENT FOR RURAL THAILAND IN RELATION TO THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Muttamara, and H. P. Ricarte.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 51-58, 1986. 1 tab, 1 ref.

Descriptors: *Pollution control, *Water pollution control, *Solid wastes, *Thailand, *Solid waste

disposal, Domestic wastes, Public health, Feces, Human diseases.

The sanitation level in the villages of Thailand is still generally low despite the past efforts of the Sanitation Division of the Department of Health. Consequently, the Royal Thai Government is embarking on a national sanitation program with a view to minimizing the occurrence of excreta related diseases in the rural communities, which will be implemented together with the rural water supply program, so as to produce the optimum effects on health. This dual program, otherwise known as the 'Thailand Decade Plan', will be initiated in 1985 and will continue until the end of 1991. The realization of this plan will serve as Thailand's commitment to the International Drinking Water Supply and Sanitation Decade. With only 2.8 million pour-flush (PF) latrines installed up to the end of 1983, accounting for 44.3% of the total households, the plan calls for the provision of an additional 2.5 million PF latrines in order to achieve the target, which is to provide 75% of households with PF latrines by the end of 1991. Considering the attitudes and economic status of the Thai rural people, the proposed strategies for the implementation of the sanitation program will be the provision of material subsidies and/or 'revolving funds', with strong support from such activities as health education, especially for women and children, and the necessary training of personnel. Implementation of the plan will require an investment of U.S.$66.4 million. (Author's abstract)
W88-03708

EVOLUTION OF LOW TECHNOLOGY WASTE WATER DISPOSAL IN THE DEVELOPED COUNTRIES AND ITS IMPLICATION FOR THE DEVELOPING NATIONS,

Washington Univ., Seattle. Dept. of Civil Engineering.
R. W. Seabloom, and D. A. Carlson.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 59-62, 1986. 2 ref.

Descriptors: *Pollution control, *Water pollution control, *Wastewater, *Waste disposal, *Developing countries, *Wastewater disposal, Wastewater treatment, Domestic wastes, Solid wastes, Solid waste disposal.

The majority of people in developing countries are without reasonable access to safe drinking water and are forced to live without proper sanitation. This lack of safe water and poor sanitation are the major cause of untold misery, disability, disease and death. The United Nations declared the 1980s as the 'International Drinking Water Supply and Sanitation Decade' with the lofty goal of safe water and adequate sanitation for all by 1990. Realizing it required about 150 years for sanitation systems to evolve in the developed nations, it is important that the developing nations learn from the mistakes made by others. The future sanitation systems for developing countries must use appropriate low cost technologies, rather than the conventional high cost water carriage sewerage technology of the developed nations. These low cost solutions, when properly sited, designed, constructed and maintained, are no less prestigious and, as the overall environmental impacts become understood, are the preferred solution in many instances. (Authors' abstract)
W88-03709

TREATMENT OF SEPTAGE - SCANDINAVIAN PRACTICE,

Aquateam-Norwegian Water Technology Centre of Oslo (Norway).
A. S. Eikum, and B. Paulsrud.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 63-70, 1986. 3 fig, 3 tab, 12 ref.

Descriptors: *Pollution control, *Water pollution control, *Wastewater treatment, *Scandanavia, *Septic wastewater, *Septic tanks, Septic sludge, Wastewater disposal.

Treatment of septage (septic tank pumpings) has for several years drawn considerable attention among scientists, design engineers and pollution control authorities in Scandinavia. In Norway about one-third of the population is living in rural areas using on-site wastewater disposal systems (i.e. septic tank-soil absorption/sand filter systems or closed tank systems). In addition, most of the sewage treatment plants are small and unsuitable for septage handling. During the 1970s research projects were initiated to find reliable data on both quantities and characteristics of septage in Norway. Several full scale demonstration plants with septage addition were investigated. Information from these projects was used to establish national guidelines on septage handling and disposal. Today both co-treatment of septage and sewage and independent treatment of septage are used throughout Scandinavia. Several plants also include separate treatment of septage liquor. Mobile septage dewatering trucks are also on the market. These systems are now considered to be proven technology and they give the municipalities a new alternative to solve the septage problem. (Authors' abstract)
W88-03710

INTERNATIONAL COOPERATION FOR THE IMPROVEMENT OF ENVIRONMENTAL SANITATION BY JAPAN,

Ministry of Health and Welfare, Tokyo (Japan).
H. Unno, and S. Yamamura.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 71-77, 1986. 2 fig, 4 tab, 10 ref.

Descriptors: *Pollution control, *Water pollution control, *Foreign projects, *Japan, *Foreign trade, *Sanitation, *Water supply, Sanitary engineering, Water supply development.

Japan has made remarkable progress in water supply and sanitation during the past 100 years. On the other hand, many developing countries lack adequate water supply and sanitation facilities, which causes high mortality rates. The International Drinking Water Supply and Sanitation Decade has been promulgated by the UN since 1981 to cope with this problem. Japan has made efforts to develop foreign assistance projects in the water supply and sanitation field since 1968. Recently these activities have been expanded. However, there exist many problems in Japanese economic and technical assistance partly because Japan has rather less experience in foreign assistance than other advanced countries. Therefore effective measures should be taken to conduct more appropriate foreign aid programs. (Authors' abstract)
W88-03711

EXPERIMENT ON MUNICIPAL WASTEWATER TREATMENT IN BANGKOK, THAILAND,

Bureau of Sewage Works, Kyoto (Japan).
J. Sumiyama, J. Matsushita, and K. Suwanarat.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 79-86, 1986. 11 fig, 3 tab, 8 ref.

Descriptors: *Pollution control, *Water pollution control, *Municipal wastewater, *Thailand, *Septic wastewater, Sanitary wastewater, Wastewater disposal, Septic tanks, Wastewater treatment.

Due to the explosive urbanization of Bangkok, it was realized that it would be difficult to adapt the conventional sewage system to cope with the increased load. It was more feasible to collect wastewater by the existing drains and to adopt a modified aeration method for treatment of typical municipal wastewater, namely effluent from on-site septic tanks. An experimental test plant was constructed to evaluate the treatability of municipal wastewater generated from the major drainage area, in comparison with that of conventional wastewater from a new community with a separate sewer system. The results verified the higher treatability of the municipal wastewater compared to the communal wastewater with respect to effluent water quality, settleability of mixed liquor, solids production, etc. In hot climates, the same effluent quality as that of the conventional activated sludge process in temperate climates can be obtained by modified aeration in cases where the influent loading is reduced by septic tank systems. (Authors' abstract)
W88-03712

SANITATION AND UTILIZATION OF NIGHT SOIL IN RURAL AREAS,

Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
K. C. Shin.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 87-94, 1986. 2 fig, 5 tab, 3 ref.

Descriptors: *Pollution control, *Water pollution control, *Solid waste disposal, *Korea, *Biogas plants, Solid wastes, Waste disposal, Septic wastewater, Sanitary wastewater.

In the past the concentration of population in the big cities of Korea led to the neglect of interests of the rural population. Of late, even though living conditions have become visibly better, sanitary conditions have not been attended to and consequently have remained bad. In the course of a research program which took place between German and Korean institutes, not only the utilisation and treatment of nightsoil, but also model types of toilets, suitable for Korea, were examined. Based on the results of investigations of 4 different types of toilets, a new type (KISTLET) was developed, especially for rural areas with limited water supply and without sewage systems. Up to 1975 about 29,000 simple biogas plants had been set up in Korea. In order to avoid the disadvantages of small plants a central plant with a digester capacity of 100 cu m was built. Nineteen percent of the gas produced was used for heating the digester, and warm water was prepared using solar energy. This plant was followed by a larger plant with a digester volume of 600 cu m. A rural household could save 32% of its energy expenses by using biogas. (Author's abstract)
W88-03713

NORTH AMERICAN AND EUROPEAN EXPERIENCE WITH BIOLOGICAL TOILETS,

Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. F. Kreissl.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 95-102, 1987. 22 ref.

Descriptors: *Pollution control, *Water pollution control, *Solid waste disposal, *Waste disposal, *Biological toilets, Solid wastes, Domestic wastes, Toilets.

A history of North American and European experience with biological toilets is provided. The early use of these devices in Scandinavia was to solve a specific problem, that of providing a low-cost solution for disposing of human wastes from recreational cabins. Because of their environmental attractiveness their popularity increased rapidly and their marketing area was widened to include year-round use. These same factors resulted in closer scrutiny by both Scandanavian and American agencies in the form of controlled and field testing programs. The results of these tests have been improved designs and understanding of the viable applications of these devices, which are significantly more limited than first implied. In essence, biological toilets are, like any other technology, a tool which has a certain limited applicability, and like any other waste management tool, is an appropriate choice where septic tank-soil absorption systems are not feasible and simpler latrine systems are not desirable or acceptable. They share this portion of the market with such devices as incinerating toilets, which are more energy-intensive and expensive to operate and provide no opportunity for nutrient recycling. (Author's abstract)
W88-03714

MODELS FOR AQUACULTURAL TREATMENT OF SEPTAGE,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
K. K. Bhattari, C. Polprasert, and B. N. Lohani.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 103-112, 1987. 7 fig, 12 ref.

Descriptors: *Pollution control, *Water pollution control, *Septic wastewater, *Biological wastewater treatment, *Tilapia, *Wastewater treatment, Algae, omestic wastes, Aquaculture.

A research program on aquacultural treatment of nightsoil has been conducted at the Asian Institute of Technology for 10 years. This paper describes the research scheme in which nightsoil is fed directly into single-stage, non-flow-through ponds for the production of algae and Tilapia fish. The culture of herbivorous fish in the same pond to graze on the algae is practical, in order to produce the fish protein biomass which is easily harvestable for animal or human food. Dynamic and empirical models describing the performance of nightsoil-fed fish ponds were developed to stimulate the temporal changes of various physico-chemical and biological parameters including dissolved oxygen, carbon dioxide, bacteria, algae, and fish growth. These models were based on the basic mechanisms and phenomena occurring in the ponds, and the simulated results calculated from the Continuous System Modeling Program computer package available at the AIT Regional Computer Center. The empirical models of fish growth and dissolved oxygen at dawn are simple, and can accurately predict (in static fish ponds fed with septage) the mean individual fish weight and the dissolved oxygen at dawn. The chemical oxygen demand of pond water increases with the daily addition of impulse loads. It was initially hypothesized that this increase was caused by an accumulation in suspension of the non-biodegradable portion of the input COD; the increase was later verified with the simulation model. (Authors' abstract)
W88-03715

PEOPLE WHO GET IN THE WAY: CHANGING VALUES IN URBAN WASTE MANAGEMENT,
York Univ. (England). Inst. of Social and Economic Research.
C. Furedy.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 121-128, 1986. 18 ref.

Descriptors: *Pollution control, *Water pollution control, *Waste disposal, *Social impact, *Social aspects;, Public health, Human diseases, Solid waste disposal, Solid wastes, Domestic wastes.

The need for better understanding of sociocultural factors --behaviors and attitudes-- is recognized as important to advances in waste disposal and treatment for developing countries. This understanding must include the views of planners and administrators and not merely the recipients of basic services. This paper focuses on issues related to waste reuse in cities. It is argued that there must be more research on informal waste treatment and use as customary practices (e.g. in aquaculture and urban agriculture) may form the basis for integrating reuse into community disposal and treatment. This will require changes in the attitudes of officials who often disregard established practices. Adapting informal waste reuse to urban development will raise difficult policy issues that social and medical research may clarify but not necessarily resolve. Examples are drawn from Calcutta and Lucknow. (Author's abstract)
W88-03717

FACTORS INFLUENCING THE SELECTION OF APPROPRIATE SANITATION TECHNOLOGY,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
Y. Magara, S. Kunikane, and S. Aoyama.
Water Science and Technology WSTED4, Vol. 18, No. 7/8. p 129-136, 1986. 5 fig, 4 tab.

Descriptors: *Pollution control, *Water pollution control, *Domestic wastewater, *Water pollution effects, Municipal wastewater, Sanitary wastewater, Wastewater disposal, Domestic wastes, Wastewater pollution.

This paper deals with the adverse effects of domestic wastewater on water utilization occurring as a result of a deteriorating water environment caused by the lack of an adequate domestic wastewater management system in Japan. Available domestic wastewater management systems are summarized from the viewpoints of performance and administration. Further, the factors to be considered in selecting an appropriate domestic wastewater management system for a projected area are discussed, and one typical example of a water environment, conserved well by comprehensive implementation of domestic wastewater management, is given. Adverse effects have been the presence of environmental carcinogens and related pollutants in drinking water, decreasing amenity of waterways, and decreasing availability of environmental water for agricultural purposes. (Authors' abstract)
W88-03718

GENERAL REVIEW AND NEW CONCEPTS REGARDING THE DEVELOPMENT OF HUMAN WASTEWATER TREATMENT IN JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan).
T. Goda.
Water Science and Technology WSTED4, Vol. 18, No. 7/8. p 137-145, 1986. 5 fig, 6 tab, 8 ref.

Descriptors: *Pollution control, *Water pollution control, *Wastewater treatment, *Japan, Wastewater pollution, Sanitary wastewater, Municipal wastewater, Biological oxygen demand, Chemical oxygen demand.

Japanese human wastewater treatment and disposal since 1945 is reviewed. The present situation regarding night soil treatment is described. The public sewerage works have been inactive due to financial reasons since 1981, and thus small to medium sized biofilm type facilities are receiving various kinds of grey water and composite household waste. This type of compact, biofilm treatment became popular because of its inexpensive construction and energy-saving characteristics. The numbers and types of biological processes currently in use in Japan are detailed, and an overview is given of industrial waste treatment and its relationship with public sewage treatment. The overall COD flow is indicated, with the amount of waste per capita, estimated from the actual water consumption. The unit load values of BOD, COD, etc. are shown, and are used for the calculation of COD load. (Author's abstract)
W88-03719

NIGHT SOIL FOR BIOGAS - FROM ASIA TO AFRICA,
Jomo Kenyatta Coll. of Agriculture and Technology, Nairobi (Kenya). Dept. of Building And Civil Engineering.
I. Kyu, and G. Muturi.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 147-155, 1986. 3 fig, 2 tab, 2 ref.

Descriptors: *Pollution control, *Water pollution control, *Wastewater disposal, *Methane, *Gasification, Biodegradation, Microbial degradation, Domestic wastes, Animal wastes, Farm wastes, Manure, Feces.

Putting human waste into productive use is considered to be part of its effective management. While the increasing demand for fuelwood, leading to deforestation, is getting serious in Africa, the technology of generating biogas from nightsoil along with animal wastes as an alternative household fuel appears to be promising. In this regard there is a need to integrate advanced Asian biogas technology into African practices of living and farming. The present study is firstly based on a literature survey to review and evaluate the various Asian biogas models so as to identify the technology most suitable to African countries while taking into consideration local materials and skills available. In applying the biogas technology, cost of construction appears to be the most important concern and emphasis is given to the development of a system which is not only technically sound but also cost-saving. Social factors are also important for further spreading of the technology, and these are analyzed as to the sequence required for successful implementation. (Authors' abstract)
W88-03720

POLLUTANT LOAD FACTOR OF HOUSEHOLD WASTEWATER IN JAPAN,
Yamaguchi Univ. (Japan). Dept. of Civil Engineering.
M. Ukita, H. Nakanishi, and M. Sekine.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 157-167, 1986. 10 fig, 8 tab, 11 ref.

Descriptors: *Pollution control, *Water pollution control, *Domestic wastes, *Water pollution sources, *Japan, *Wastewater pollution, Municipal wastewater, Raw wastewater, Sanitary wastewater, Wastewater disposal, Pollution load, Biological oxygen demand, Chemical oxygen demand, Nitrogen, Phosphorus.

This study clarifies quantitatively the role of household wastewater as one of the causes of the rapid pollution of nearby waterbodies and to consider the importance of countermeasures at the stage of pollutant load generation. Using mass balance techniques, actual samples and measurements, or by referring to the literature, reliable values of the pollutant load factor or household wastewater were obtained for both the residential and occupational population and after every type of treatment system. Then, to verify the reliability of these values, the flow-out rate of the pollutant load from small river basins was investigated in fine weather. The results show that the proposed values of the pollutant load factor were appropriate, and cesspool night soil and miscellaneous household wastewater are the main causes of the pollution of nearby waterbodies. The results of several experiments show that awareness regarding pollutant load at the stage of its generation, e.g. in cooking and dining, can greatly reduce the pollutant load. (Authors' abstract)
W88-03721

USE OF ANTHRACITE ASH AS A MEDIA FOR A FIXED-FILM BIOLOGICAL PROCESS,
Lotte Engineering and Machinery Mfg. Ltd., Seoul (Korea). Environmental Div.
K. S. Kim, and E. Choi.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 169-175, 1986. 7 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Biological wastewater treatment, *Coal ash, *Korea, Biological filters, Biofilters, Anthracite.

Many Korean communities have utilized about 2 billion anthracite briquettes as a major fuel for house heating. This study evaluated the use of combusted briquettes as media for a fixed-film biological process. Various industrial wastes as well as municipal wastewater were introduced into the aeration tank where the briquettes were placed. The briquette system produced effluent BOD concentrations fairly similar to those from units using plastic media. A combusted briquette has a specific surface area of 73 sq m/cu m, about 20-30% less than plastic media. Fresh briquettes adsorbed organics at 500 mg COD/kg briquette within 24 hours of aeration. Micro-organisms attached well to the briquette surface under aeration. The maximum solids retention capacity was about 60 g SS/sq m, or 10% less than that of plastic media. (Authors' abstract)
W88-03722

PERFORMANCE OF THE ROTATING DISC SYSTEM UNDER THE TROPICAL CONDITIONS IN TAIWAN,
Feng Chia Univ., Taichung (Taiwan).
P.-S. Cheung.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 177-183, 1986. 8 fig, 2 tab, 22 ref. National Science Council of the Republic of China Grant No. NSC 72-0406-E035-R02.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Taiwan, *Septic wastewater, Municipal wastewater, Biological oxygen demand, Biological treatment.

The discharge from a septic tank and community wastewater were treated in a pilot scale rotating

disc system to evaluate its performance under tropical conditions in Taiwan with the intention of developing design criteria useful for this region. By varying the organic loading to the system, different degrees of treatment would be obtained. With an organic loading 0f 8-10 g BOD/sq m/day, 90% removal of BOD as well as NH4-N removal could be achieved. Ambient temperature was found to have no significant effect on the treatment efficiency, and the optimum hydraulic detention time was within 3 hours. Biological sludge production amounted to 0.6 to 0.8 kg/kg BOD removed. (Author's abstract)
W88-03723

STUDIES ON THE CONTACT BIOFILTER AS A COMPACT PROCESS IN DOMESTIC SEWAGE TREATMENT,
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
I. Somiya, H. Tsuno, and Y. Ono.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 185-192, 1986. 9 fig, 3 tab, 2 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Biological treatment, Biological filters, Biofilters, Domestic wastes.

The performance of a newly developed compact treatment process, the 'contact biofilter', is described. It is composed of a submerged biofilter and a granular medium filter. Experiments were conducted using domestic sewage. The process reduced SS and total BOD in effluent to below 10 and 20 mg/liter, respectively, in a short retention time of 1.1-2.1 hours, and can be used as a secondary treatment process. The organic substances in sewage are effectively recovered as sludge without extensive mineralization, in the range of 0.13-0.35. The sludge withdrawal ratio was in the range of 1.05-1.43. (Authors' abstract)
W88-03724

FIXED ACTIVATED SLUDGE MAKES SEWAGE TREATMENT SIMPLE,
Tehran Univ. (Iran).
A. Mesdaghinia.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 193-198, 1986. 2 fig, 3 tab, 6 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Activated sludge, Biological treatment, Biological filters, Biofilters, Domestic waste.

A bench scale study of fixed activated sludge is reported. Two different units employing diffused aeration with plastic and aluminum media were studied in four separate phases. The system could produce a high quality effluent without any requirements for sludge recycling through the system. Suspended solids concentrations of 3-6 mg/liter, BOD5 concentrations of 4-12 mg/liter, and COD concentrations of 35-45 mg/liter were fouond in the effluent with wastewater retentions ranging from 3-15 hours. Indication of nitrification was observed with higher detention periods. The plastic and aluminum media did not differ significantly once the microbes had grown on the media. The fixed activated sludge system employing diffused aeration appears to be a suitable method of domestic wastewater treatment in areas lacking skilled operators. Sludge recirculation can be eliminated with the fixed activated sludge since the microbes are retained on the fixed media in adequate numbers for rapid metabolism of organic wastes. (Author's abstract)
W88-03725

NIGHT SOIL TREATMENT BY BIOLOGICAL FLUIDIZED BEDS,
Chungbuk National Univ. (Korea). Dept. of Civil Engineering.
H. G. Kim, and Y. D. Lee.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 199-208, 1986. 8 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Biological treatment, Domestic wastes, Solid waste disposal, Feces.

This paper estimates the possibility of, and mathematical analysis of, the use of biological fluidized beds (BFB) in the treatment of night soil with low dilution rates. An experiment was conducted using a continuoustype reactor at 20 C, varying F/M ratio from 0.12 to 0.37 and dilutionratio from 2 to 10, with matted reticulated polypropylene sheets for the solid supports. The results showed that the use of BFBs for the treatment of night soil would be more effective than any other biological treatment process. The optimum dilution ratio was about 5-fold. The optimum hydraulic retention time was about 17 hours. In comparison with other biological treatment processes, the reactor volume and the quantity of dilution water could be reduced by 70% and 80%, respectively. The experimental results for BFBs can be analyzed by the same mathematical models applied to completely mixed activated sludge processes. The substrate removal rates obtained using the equations of McKinney and Eckenfelder were 1.784/hr and 0.002 liter/mg day. Substrate was removed very rapidly compared to conventional type biological treatment processes. The biomass yield coefficient was 0.349. The endogenous respiration rate was 0.237/day. The synthesis oxygen demand rate was 0.495. The endogenous respiration oxygen demand rate was 0.0336. If night soil diluted 5-fold is treated with the BFB process, the volume of the reactor can be reduced 60%, and quantity of dilution water 80%, as compared to the activated sludge process. Excessive growth of filamentous organisms did not cause any problems. Good effluent quality was obtained without a secondary clarifier. Matted reticulated polypropylene sheets are well suited for use as the support material. (Authors' abstract)
W88-03726

DOMESTIC SEWAGE TREATMENT USING AN ANAEROBIC BIOFILTER WITH AN AEROBIC BIOFILTER,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
Y. Inamori, R. Sudo, and T. Goda.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 209-216, 1986. 8 fig, 6 tab, 8 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Biological filters, Biofilters, Domestic wastes, Anaerobic digestion, Aerobic digestion.

This study assessed the applicability of the anaerobic biofilter process to treat low strength organic wastewater such as domestic sewage. It was found that when the influent BOD was approximately 200 mg/liter, water temperature and BOD loading, under a hydraulic retention time of 30 hours, were 20 C and 0.2 kg/cu m/day, respectively. A BOD removal of at least 70% was attained. The ratio of sludge produced to BOD removed in the anaerobic filter was as low as 0.1. It was also found that 75% of nitrogen could be removed in the anaerobic-aerobic biofilter process when the circulation ratio was more than 1.2. (Authors' abstract)
W88-03727

TREATMENT CHARACTERISTICS OF THE TWO PHASE ANAEROBIC DIGESTION SYSTEM USING AN UPFLOW FILTER,
Meisei Univ., Tokyo (Japan). Dept. of Civil Engineering.
S. Tanaka, and T. Matsuo.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 217-224, 1986. 9 fig, 4 tab, 21 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Waste treatment, Milk, Dairy industry, Industrial wastewater.

The treatment characteristics of dilute milk wastes (1500 COD/liter) were investigated by the two phase anaerobic digestion system consisting of a completely mixed reactor for acidogenesis and an upflow filter for methanogenesis. The system removed 92% of the influent COD at an overall hydraulic detention time of 4.4 days. Carbohydrates in the milk were most extensively decomposed (95%), next proteins (50%), while lipids were rapidly hydrolized to long-chain fatty acids but not degraded during the acid phase. The phase separation had an effect on reducing the toxicity of long-chain fatty acids to both acetogenic and methanogenic bacteria. The rates of sludge production were 0.257 mg VS/mg COD utilized during the acid phase and 0.043 mg VS/mg COD utilized during the methane phane. This low sludge production in the methane filter made possible long periods of operation without sludge wasting. The system proposed in this study could accept shock loads of a three-fold increase of the influent COD. (Authors' abstract)
W88-03728

ANAEROBIC WASTEWATER TREATMENT USING FLOATING MEDIA (DEVELOPMENT OF THE UPFLOW FLOATING ANAEROBIC FILTER PROCESS),
Dong-A Univ., Pusan (Korea). Dept. of Environmental Engineering.
Y. M. Oh, and B. S. Yang.
Water Science and Technology WSTED4, Vol. 18. No. 7/8, p 225-237, 1986. 7 fig, 10 tab, 13 ref.

Descriptors: *Wastewater Treatment, *Biological Wastewater Treatment, *Anaerobic digestion, Biological filters, Biofilters, Biological treatment, Biological oxygen demand.

An anaerobic process and the upflow anaerobic sludge blanket process were modified to develop a feasible alternative anaerobic wastewater treatment method. Polypropylene rings were used in the reactors as the floating media to maximize solids retention time, even at short hydraulic retention time. Clogging and plugging problems were solved by fluidizing the media with the biogas produced in the reactor. The mechanisms and applicability of the modified process were evaluated using artificial wastewater composed of glucose and non-fat dry milk at a level of 500-2000 mg/liter total chemical oxygen demand. Low strength wastewater like municipal sewage could be treated to the level of acceptable quality with 87% total BOD removal efficiency at hydraulic retention times shorter than 6 hours. The solids retention time gradually became independent from the hydraulic retention time during the period of microbial attachment to the media. Organic shock loading and a certain range of temperature variation (27-37 C) did not significantly affect the organic removal efficiency. This is thought to be mainly due to accumulation of micro-organisms in the reactor. Granular sludge with a diameter of 1 to 5 mm was formed, which settled very rapidly. A final clarifier may not be needed, because of low suspended solids in the effluent. Plugging and clogging problems could be solved through fluidizing the media, by impulse input of the biogas produced into the reactor. (Authors' abstract)
W88-03729

MATHEMATICAL MODEL FOR THE ANAEROBIC DIGESTION PROCESS APPLIED TO A MIXTURE OF NIGHT SOIL AND SEPTIC TANK SLUDGE,
Thew Korea Inst. of Construction Technology, Inchon.
S. R. Ha, D. H. Lee, and S. Lee.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 239-248, 1986. 8 fig, 3 tab, 15 ref.

Descriptors: *Model studies, *Wastewater treatment, *Anaerobic digestion, Septic sludge, Feces, Mathematical models, Solid waste disposal.

The upgrading of night soil anaerobic digestion processes was studied by field investigation of the performance of anaerobic digesters in existing night soil treatment plants and by semi-continuous experiments with bench scale digesters. Both the average monthly amount of collected night soil fed to a digester and the concentration of volatile solids in night soil increased in winter. A good correlation was found to exist between gas production and digestion temperature. The COD removal rate in the first digester was markedly higher than that in the second digester. The stirring period in the first digester in one plant differs from that in the other plant. Stirring the first digester for too

long a period reduces the rate of COD removal by the second digester in the two-stage anaerobic digestion process. The first digester should be stirred for more than one hour per day to promote gas production. Gas production and COD removal rate in the second digester were hardly affected by reductions in retention time ranging from 15 to 5 days. As night soil contains a large amount of cellulose and other refractory organics, some kind of pretreatment of the night soil fed to the digester may be necessary for the promotion of acidogenesis in the two-phase anaerobic digestion process. (Authors' abstract)
W88-03730

MICROBIAL QUALITY OF HUMAN WASTES AND TREATMENT PLANT EFFLUENT,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
K. Kawamura, and M. Kaneko.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 257-265, 1986. 7 fig, 2 tab.

Descriptors: *Wastewater treatment, *Bioindicators, *Pathogens, *Disinfection, *Microorganisms, Microbiological studies, Bacteria, Salmonell Staphylococcus, Clostridium, Vibrio.

The microbial flora of samples of human wastes and effluents from treatment processes was examined. Total coliforms, fecal coliforms and fecal streptococci were used as indicator organisms. Vibrio cholerae non O-1, Salmonella, Staphylococcus aureus, and Welchii (Clostridium perfrigens) were selected as pathogenic organisms. Salmonella were detected only in the water samples from the night soil treatment plant. Staphylococcus aureus was detected in the night soil and the samples from the night soil purification tanks. Vibrio cholerae non O-1 was not detected in any samples. Welchii existed in almost all samples. Generally, the density levels and distribution patterns of the indicator micro-organisms were similar to those in the raw wastewaters. The microbial flora was not changed remarkably after the primary sedimentation process and the biological treatment process. After the chlorination process, total colonies, spore-forming bacteria, Welchii, moulds and fecal streptococci could survive, and spore-forming bacteria formed the majority of the total colonies in the well chlorinated effluents. Welchii at the level of 1000/100 ml can be used as the indicator micro-organism to ensure a sanitary safe discharge because it can survive at the level of 1000 to 10,000 per 100 ml even if other indicators and pathogenic micro-organisms are inactivated completely by the chlorination process. (Authors' abstract)
W88-03731

ADSORPTION OF COLIPHAGES TO PARTICULATES,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
S. Ohgaki, A. Ketratanakul, S. Suddevgrai, U. Prasertsom, and O. Suthienkul.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 267-275, 1986. 7 fig, 1 tab, 19 ref.

Descriptors: *Wastewater treatment, *Bacteriophages, *Coliphages, *Adsorption, vColiforms, Viruses, Microorganisms, Escherichia coli.

Adsorption characteristics of coliphages (host cell: E. coli B) to particulates (kaolin, sand, soil, microbial particulates in an oxidation pond) were investigated using batch experiments under various conditions of pH, concentrations of cations, and concentrations of dissolved oxygen. The coliphages showed no resistance to acid (pH 3) and weak resistance to alkali (pH 10). Under neutral pH conditions, sodium ions did not have a large effect on the adsorption of coliphages to the solid surfaces of sand. Divalent cations (Mg(2+), Ca(2+)), had no effect on the adsorption to sand at concentrations below 0.01 mol/liter, but some affect at 0.05 and 0.1 mol/liter. The presence of kaolin had very little effect on removal of coliphages from the water phase under any conditions. Formation of flocs such as Mg-hydroxides in alkaline conditions enhanced coliphage removal from the water phase. Coliphage chemical adsorption to particulates in natural waters would probably be low except in estuarine and sea waters. However, the adsorption of coliphages was observed under anaerobic conditions. This adsorption-desorption process was reversible. The biological adsorption appears to be the dominating cause of coliphage adsorption in natural waters containing microbial particulates. (Authors' abstract)
W88-03732

OXYGEN DEPLETION MODELLING, PORT SHELTER, HONG KONG,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5B.
W88-03733

CHARACTERISTICS OF COMMUNITY WASTEWATER BIOLOGICAL TREATMENT PROCESSES IN TAIWAN,
National Central Univ., Chung-Li (Taiwan).
C. F. Ouyang, and T. J. Wan.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 289-296,1986. 8 fig, 3 tab, 3 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Taiwan, Biological treatment, Biological filters, Biofilters, Biological oxygen demand. demand.

This study compares the treatment characteristics of three different kinds of biological wastewater treatment plants (rotating biological contactor, trickling filter, and oxidation ditch) operated in Taiwan. Field investigation concentrated on: biological oxygen demand and suspended solids removal; sludge yield rate of BOD removal; settleability of sludge solids; properties of sludge thickening; power consumption and land area requirement per unit volume of wastewater. Sludge yield of the trickling filter process was less (0.18 kg SS/kg BOD removed) than rotating biological contactor (0.61) or oxidation ditch (0.71). Very good settleability was observed for all three processes. Attached growth biological sludge was more difficult to thicken than suspended growth sludge. Power consumption was least for the rotacting biological contactor process (1.37 kWh/kg BOD removed), moderate for trickling filter (2.56), and greatest for the oxidation ditch process (8.23). The land area requirement was directly affected by hydraulic detention time, being greatest for the oxidation ditch (3-35 hrs) and least for the rotating biological contactor (0.7-1.8 hrs). The oxidation ditch required the largest land area (0.35 sq m/cu m wastewater/day). The trickling filter required 0.78 sq m/kg BOD removed, while the rotating biological contactor needed 0.44 sq m/kg BOD removed. (Authors' abstract)
W88-03734

PERFORMANCE EVALUATION OF THE OXIDATION DITCH PROCESS,
Japan Sewage Works Agency, Toda. Research and Technology Development Div.
K. Matsui, and T. Kimata.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 297-306, 1986. 10 fig, 2 tab, 1 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Oxidation ditches, Biological oxygen demand, Nitrogen, Alkalinity.

The oxidation ditch process has become increasingly important as a secondary treatment process for small communities because of its ability to remove nitrogen by providing aerobic and anaerobic areas in a ditch. Surveys of three oxidation ditches in service in Japan have proven that removals of BOD and suspended solids could be consistently achieved irrespective of seasonal, daily and hourly fluctuations of inflow. Providing an anoxic area in the oxidation ditch is effective for removing nitrogen and recovering alkalinity as well as saving energy. The removal efficiency of total nitrogen is expected to be more than 70 percent. The settling velocity of sludge in the oxidation ditch is very small, with a sludge interface being formed. A picket fence in the settling tank improved sludge settleability. (Authors' abstract)
W88-03735

INTENSIFICATION OF ACTIVATED SLUDGE WASTE WATER TREATMENT,
Budapesti Mueszaki Egyetem (Hungary). Dept. of Agricultural Chemical Technology.
A. Donath-Jobbagy, J. Kalman, and R. Hajos.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 307-311, 1986. 1 fig, 4 tab.

Descriptors: *Wastewater treatment, *Activated sludge, Activated carbon, Adsorbents, Chemical oxygen demand, Milk.

The efficiency of two possible intensification methods of activated sludge waste water treatment (pure oxygen activation and activated carbon addition) was compared. Experiments were carried out in laboratory scale equipment with variable reactor volume (maximum capacity 20.0 cu dm, settling tank volume 15 cu dm). In order to detect even minor differences, completely identical units were operated in parallel runs, with one representing a traditional system as reference. A model sewage of industrial character, diluted milk, was used as influent and, in the course of activated carbon intensification experiments, an anion-active detergent was added as a poorly biodegradable model material to be removed mainly by adsorption. Reactor loads were gradually increased, from low values to overloading, by decreasing the dilution of milk or by reducing reactor volume. The effects of different intensification methods on the effluent pollution level (COD value and anion-active detergent content) and on the settling properties of sludge were examined as a function of loading. The efficiency of both intensification methods was found to be increasing with increasing loading. Comparison of the two systems showed activated carbon intensification to be more efficient in the removal of soluble COD and extremely useful in the elimination of a poorly biodegradable material. (Authors' abstract)
W88-03736

OPERATION AND MAINTENANCE OF SMALL SCALE WASTEWATER TREATMENT PLANTS,
Ministry of Construction, Ibaraki (Japan). Sewage Works Section.
M. Takahashi.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 313-318, 1986. 6 fig, 1 tab.

Descriptors: *Wastewater treatment, *Oxidation ditches, Aeration, Activated sludge, Culturing techniques, Sludge.

Three wastewater treatment processes (oxidation ditch, extended aeration, and activated sludge batch reactor) considered suitable for small scale wastewater treatment plants were tested at a pilot plant or using existing facilities to examine their methods of operation and maintenance. The objectives were to determine production of excess sludge, a method for setting aeration intensity, and a method of controlling returned sludge. Sludge production in the oxidation ditch was 60-75% of the removed suspended sludge, and the suspension of the drawing of excess sludge did not affect the sludge production. Although the specific respiration rate of the activated sludge was affected greatly by the water temperature, the rate of oxygen consumption per liter of mixed liquor, when the SRT was held constant, was constant throughout the year. In the extended aeration process, an aeration time of 18 hours was not sufficient for satisfactory aerobic digestion of activated sludge. In the plug flow type activated sludge process, it is important to control the amount of return sludge to avoid accumulation of sludge in the final settling tank. In the activated sludge batch reactor process, a high removal ratio of nitrogen was obtained by conducting intermittent aeration. (Author's abstract)
W88-03737

SIMULTANEOUS NITROGEN AND PHOSPHATE REMOVAL BY THE INTERMITTENT CYCLIC PROCESS,
Nishihara Environmental Sanitation Research Corp. Ltd., Tokyo (Japan).

N. Hayakawa, J. Tsuji, and Y. Hamamoto.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 319-326, 1986. 8 fig, 5 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Biological treatment, Nitrogen, Phosphorus, Anaerobic digestion, Aerobic digestion.

Domestic sewage was treated at a rate of 18 cu m per day using the Intermittent Cyclic (IC) process which repeats aerobic and anaerobic conditions in an 18 cu m pilot plant reactor. Operating condition was 4 cycles per day as 4 hours of intermittent aeration, 1 hour of settling, and 1 hour of drawing per cycle. High rates of nitrogen removal (mean 86%, maximum 96%) and phosphate removal (mean 83%, maximum 93%) were recorded during seven months of operation. Compared with conventional aerobic/anaerobic processes, the batch-type IC treatment process can advantageously and stably remove nitrogen and phosphate with repeated aeration and nonaeration under optimal control. The IC process also removed organic substances to a great extent without the aid of organic carbon sources and chemicals. To obtain high yields in the simultaneous biological nitrogen and phosphate removal process, dissolved oxygen control in the aerobic condition is very important. In the course of alternating aeration and non-aeration, NOX-N concentration of the reactor declined in the anaerobic condition and rose in the aerobic condition. The total phosphate concentration showed, in reverse, an increase during nonaeration and decrease during aeration. Effluent T-P and NOX-N concentrations are closely correlated. To obtain a low effluent T-P concentration, the operation must be conditioned to hold the effluent NOX-N concentration at a low level. Representing a batch type that differs from aerobic/anoxic nitrogen removal processes, the IC process, requiring no recirculation, can advantageously and stably remove nitrogen and phosphate with aerating and nonaerating periods under optimal control. (Authors' abstract)
W88-03738

DEVELOPMENT OF NITROGEN REMOVAL TECHNOLOGY IN NIGHT SOIL TREATMENT BY CIRCULATED AERATION TYPE BIOLOGICAL DENITRIFICATION,
Kuboto Ltd., Osaka (Japan). Water Treatment Facilities Engineering Dept.
K. Murata, K. Shimizu, Y. Yamada, and S. Kimura.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 327-338, 1986. 5 fig, 5 tab, 5 ref.

Descriptors: *Wastewater treatment, *Denitrification, Biological wastewater treatment, Biological treatment, Aeration, Biological oxygen demand.

A circulated aeration type biological denitrification system has been developed for removing total nitrogen in night soil. In the circulated aeration tank, BOD removal, nitrification and denitrification can be simultaneously conducted by activated sludge treatment without dividing the tank into an aerobic zone and an anaerobic zone, and it is possible to remove 80-90% of the total nitrogen and BOD in night soil influent. Denitirification and re-aeration tanks are provided after the circulated aeration tank and over 99% removal of total nitrogen and BOD can be attained with the whole system. Phosphorus can also be removed to the extent that there remains only a trace and this is effective to prevent eutrophication. This system was approved by the Ministry of Health and Welfare of the Japanese Government in 1978 as a new technology for night soil treatment. (Authors' abstract)
W88-03739

NIGHT SOIL TREATMENT BY THE NITRIFIED LIQUOR RECYCLING PROCESS,
Ebara Research Co. Ltd., Fijisawa (Japan).
T. Suzuki, and Y. Tohya.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 339-346, 1986. 3 fig, 3 tab, 6 ref, append.

Descriptors: *Wastewater treatment, *Denitrification, Biological wastewater treatment, Nitrogen removal, Biological treatment, Biological oxygen demand.

Most night soil treatment plants constructed in recent years have the function of nitrogen removal. This report describes three representative night soil treatment plants adopted for a nitrified liquor recycling process. The Matsue City plant uses coagulation to remove phosphorus and color in addition to BOD and nitrogen. The removal of both BOD and phosphorus is nearly 100%. Inorganic nitrogen and color of the effluent are under 6 mg/liter and 60 units, respectively. The Shiroshi City Plant which was reconstructed from an anaerobic digestion system removes over 95% of BOD and inorganic nitrogen without the use of chemicals. At the Hiroshima City Plant, night soil is evaporated by multiple effect evaporation, and condensate is treated by the nitrified liquor recycling process. The temperature of mixed liquor is controlled to about 40 C by adding sea water to lower the temperature (over 55 C) of the condensate before the biological treatment step. Nitrogen oxides in nitrified liquor consist almost entirely of nitrite because of controlling the temperature. The removal of BOD and total nitrogen is over 99% in this plant. (Authors' abstract)
W88-03740

ADVANCED NIGHT SOIL TREATMENT BY MECHANICAL SOLIDS SEPARATION AND BIOLOGICAL PROCESSES,
Kurita Water Industries Ltd., Yokohama (Japan). Kurita Cental Labs.
Y. Murakami, Y. Ishii, and S. Kagi.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 347-354, 1986. 9 fig, 3 tab, 1 ref.

Descriptors: *Wastewater treatment, Biological wastewater treatment, *Denitrification, Biological oxygen demand, Biological treatment, Sludge.

This study describes a new method of night soil treatment where suspended solids in night soil were first removed by a rotary screen to reduce BOD loading to the following biological treatment. After treatment by a cationic polymer coagulant (1.3-1.4%/dry solids), night soil was passed through a rotary screen and separated into thickened sludge and filtrate. The thickened sludge was best dewatered by a screw press giving sludge cake with 60% moisture content. The dewatered sludge cake was combustible without supplementary fuel. The filtrate was treated by the biological nitrification-denitrification process steadily giving treated water with T-N 60 mg/liter (98% removal), BOD 32 mg/liter (99% removal), COD Mn 530 mg/liter (74% removal), color 3,400 units, and SS 110 mg/liter. Extraordinary foam trouble at the nitrification tank was not met in this process and foam was suppressed mostly by spraying nitrified liquor with the aid of an antifoam agent, as little as 0.03 kg/kl-nightsoil. For coagulation of the effluent from the biological treatment, poly (ferric sulfate) or ferric chloride was better than alum. The optimum pH for the ferric coagulants was 4-5 and the optimum dosage was 500 mg/liter as Fe. The treated water was COD Mn 90 mg/liter, color 200 units, and PO4-P less than 0.5 mg/liter. It was possible to reduce COD Mn and color to less than 20 mg/liter and 20 units, respectively, by activated carbon adsorption. (Authors' abstract)
W88-03741

NEW METHOD OF SULPHUR DENITRIFICATION FOR SEWAGE TREATMENT BY A FLUIDIZED BED REACTOR,
Kanazawa Univ. (Japan).
S. Matsui, and R. Yamamoto.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 355-362, 1986. 6 fig, 2 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Denitrification, Nitrogen compounds, Fluidized beds, Sulfur.

Denitrification is a problem in the anaerobic treatment of sewage because organic carbon and hydrogen mainly are recovered in the form of methane and not used for denitrification. Other electron donors must be introduced. Reduced forms of sulfur are promising donors. In this study thiosulfate and elemental sulfur were used in fluidized bed reactor systems. Denitrification by oxidation of sulfur was unstable due to the poor solubility of sulfur in sewage. Thiosulfate denitrification was very stable. The stoichiometric relationship of the denitrification and thiosulfate oxidation for the reactor was obtained. The denitrification process was described by the first order consecutive reactions. The rate constant of nitrate to nitrite reduction varied from 0.0205 to 0.109. The rate constant of nitrite to nitrogen reduction varied between 0.141 to 0.908 l/gVSS/l*min. (Authors' abstract)
W88-03742

PERFORMANCE OF SEQUENCING BATCH REACTOR ACTIVATED SLUDGE PROCESSES FOR SIMULTANEOUS REMOVAL OF NITROGEN, PHOSPHORUS AND BOD AS APPLIED TO SMALL COMMUNITY SEWAGE TREATMENT,
National Inst. for Environmental Studies, Tsukuba (Japan). Lab. of Freshwater Environment.
M. Okada, and R. Sudo.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 363-370, 1986. 6 fig, 2 tab, 13 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, Nitrogen, Phosphorus, Biological oxygen demand.

A laboratory-scale sequencing batch reactor (SBR) activated sludge process was fed with synthetic wastewater to investigate the possibility of simultaneous removal of nitrogen, phosphorus, and organic substances by modifying the operational schedule. Anoxic and/or anaerobic reactions, in addition to aerobic reactions, were introduced into a cycle of batch operation. Simultaneous removal of nitrogen, phosphorus and organic carbon was shown to be possible by the modified operation of SBR in which reactions without aeration (anoxic/anaerobic) were introduced during the fill period. Oxidized nitrogen remaining in the reactor at the end of the former cycle was removed by denitrification during the fill. Anaerobic conditions after the denitrification was completed enhanced phosphorus release from the sludge and the following luxury uptake during aeration removed phosphorus from water. Both extension and reduction of the anoxic/anaerobic period in the beginning of a cycle damaged phosphorus removal and sludge settlability. Thus an optimum period length for these reactions must be chosen for successful operations. The best length of this period coincided with that of the fill within the range of this study. (Authors' abstract)
W88-03743

PROLONGED EFFECT OF LAND DISPOSAL OF HUMAN WASTES ON SOIL CONDITIONS,
National Research Centre, Cairo (Egypt).
M. S. M. Saber.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 371-374, 1986. 2 tab, 11 ref.

Descriptors: *Land disposal, *Wastewater farming, Solid waste disposal, Public health, Human diseases, Soil contamination.

Land disposal of human wastes is a comprehensive issue where a series of aspects have to be considered. Few, if any, alternatives exist to this technology. No doubt future emphasis will be on sewage farming, which should result in the cultivation of new arid land. This paper addresses the prolonged effect of land disposal of human wastes on soil properties, as well as on the dissemination of enteric pathogens. In order to assess this impact, soil samples were collected from Gabal el Asfar sewage farm in Cairo to represent sandy soils irrigated solely, by surface flooding, with decanted sewage effluent for 0, 2.5, 5, 10, 15, 20, 30, 45 and 60 years. Sewage farming tended to build up the soil microbial population, particularly during the first 5 years. In all soils, human wastes increased total bacterial counts and promoted the proliferation of the physiological groups. This population would accelerate the oxidation of organic matter to available nutrients. It also resulted in a high increase in nitrogen, phosphorus, micro-nutrients,

and organic carbon, and raised the water holding capacity and exchangeable cations. However, the prolonged use of sewage effluent would disturb the balance of nutrients in soil, as the pH shifted towards acidity. The most interesting observation in the present work is to record that neither soluble salts nor micro-nutrients reached any injurious level. But the land disposal of human wastes should be exercised with caution and, if it is intended to be applied, salts, pH and nutrient elements should be checked occasionally. From the hygienic point of view, fecal E. coli, which is considered to be an indicator for enteric pathogens, gave positive results in all sewaged soils. Hence, it is recommended, from a sanitary point of view, that no crops which come in contact with sewage effluent should be cultivated in a sewage farm. (Author's abstract)
W88-03744

USE OF SOIL FOR DISPOSAL OF DOMESTIC SEWAGE,

Ebara Research Co. Ltd., Fijisawa (Japan).
G. Yamaura, T. Suzuki, M. Kobayashi, T. Katsuno, and K. Ogiwara.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 375-381, 1986. 7 fig, 4 tab, 2 ref.

Descriptors: *Land disposal, Wastewater disposal, Septic wastewater, Septic tanks, Wastewater treatment, Wastewater pollution.

Experiments using soil columns, lysimeters, and a field were conducted by permeation of outflow water from a septic tank. In experiments using soil columns, loam columns of over 25 cm in length gave removal percentages of over 90% for BOD, T-P, and coliforms. Lysimeters and a field registered removal percentages around 90% for BOD, T-P, and coliforms, but often below 50% for T-N. The field experiment was continued for 10 years without giving any indication of deterioration of quality of permeant water. A soil analysis in the field experiment revealed that the permeant water diffuses laterally 100 cm relative to the trench within the upper layer, with the diffusion range increasing to more than 300 cm with depths over 250 cm. (Authors' abstract)
W88-03745

ASPECTS OF LAND DISPOSAL OF WASTEWATER AS EXPERIENCED IN GERMANY,

Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Stadtbauwesen.
R. Boll, H. Dernbach, and R. Kayser.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 383-390, 1986. 1 fig, 6 tab, 5 ref.

Descriptors: *Land disposal, *Wastewater treatment, *Biological wastewater treatment, *Germany, Wastewater farming, Wastewater irrigation, Public health.

The largest wastewater land treatment facility in operation in the Federal Republic of Germany is located in Braunschweig (Lower Saxony) and serves a population of about 290,000. The treatment process consists of three main components: a pre-treatment plant as an activated sludge process, a sprinkler irrigation area of 3,000 ha of farmland, and an old sewage farm of 180 ha with surface flooding. The problems (odors and health risks) of sprinkling only roughly treated wastewater have more or less been solved by the installation of a biological pre-treatment plant and by establishing safety distances from streets and houses planted with hedges. The whole treatment process shows a high efficiency in purification of wastewater. Especially under sprinkler irrigation as a low rate process, tertiary standards for most pollutants are reached. The importance of wastewater irrigation on light sandy soils in Braunschweig is that farming in that specific area has become economically feasible and that there is a very little pollution from wastewater discharge into the Oker River. Disadvantages of the system are: increasing nitrate concentrations in the groundwater of the irrigation area as a result of increased application rates outside the growing season, and some problems with the emission rates of some heavy metals to the system. To reduce the application rates to the irrigation site in winter, the treatment capacity of the old sewage farm is being extended. A reduction of the load of nitrogen and heavy metals by installation of a primary sedimentation tank and a compartment type filter press for dewatering of sludge on the pre-treatment site is being considered. Generally, because of the considerable construction and operation costs, in comparison with conventional treatment processes, land treatment will only have a chance of installation if wastewater purification as the first goal can be combined with a second goal, as for example, groundwater enrichment or agricultural irrigation, and, especially if considerable application rates are possible. (Authors' abstract)
W88-03746

NUMERICAL SIMULATION OF A SOIL FILTRATION TREATMENT BASED ON BALANCE,

Tokyo Univ. (Japan). Inst. of Industrial Science.
M. Suzuki, H. Kawashima, and T. Kawanishi.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 391-396, 1986. 5 fig, 1 tab, 4 ref.

Descriptors: *Land disposal, *Model studies, *Wastewater treatment, Wastewater disposal, Biological oxygen demand, Filtration, Oxygen.

A sophisticated 2-dimensional model to simulate the concentration distributions of BOD, oxygen and biomass in a soil filtration treatment system is presented. The model incorporates, in addition to infiltration of wastewater, oxygen diffusion in the soil and bacterial growth and respiration. The matrix potential concept was used to describe two dimensional infiltration from the source. The model showed that the distribution patterns of biomass in a soil are governed both by the rate of oxygen diffusion and by the wastewater infiltration rate. Applying the model to a trench type plant under ordinary operating conditions, it became apparent that only the soil adjacent to the trench is utilized for the treatment. A higher oxygen diffusion rate in a soil makes the biomass growth area smaller and a lower rate makes it larger. Under ordinary operating conditions, biomass will increase only near the trench. Soil that has a large oxygen diffusion rate constant would be good for a soil filtration treatment system. (Authors' abstract)
W88-03747

EFFECTIVENESS OF WASTEWATER SLUDGE TREATMENT PROCESSES TO INACTIVATE PARASITES,

Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
R. S. Reimers, D. B. McDonell, M. D. Little, D. D. Bowman, and A. J. Englande.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 397-404, 1986. 23 ref.

Descriptors: *Parasites, *Sludge treatment, *Diseases, Human diseases, Public health, Epidemiology, Sludge, Sludge disposal, Solid waste disposal.

In the United States, Ascaris species, Trichuris trichuria, Trichuris vulpis and Toxocara species are the most comonly found viable parasites in both treated and untreated municipal sludges. As expected, heat treatment, thermophilic digestion (aerobic and anaerobic) and thermophilic composting were effective in parasite inactivation. With good sludge digestion (both aerobic and anaerobic), the effectiveness of sludge lagoon storage and sludge drying beds to inactivate parasites and pathogens is greatly enhanced. At present, two commercial sludge processes have shown potential to inactivate parasites. The pathogen requiring the most treatment for inactivation is Ascaris. The effectiveness of Ascaris inactivation fluctuates and depends on the degree of sludge stabilization along with further treatment such as lime stabilization, ammonification, sludge drying, etc. If a sludge treatment system is properly managed, Ascaris eggs can be effectively inactivated with little additional cost. (Authors' abstract)
W88-03748

WASTEWATER TREATMENT BY SOIL-COVERED CONTACT AERATION APPARATUS UNDER EXTREMELY LOW AIR TEMPERATURES,

Capillary Purification Research Society, Tokyo (Japan).
G. I. Matsumoto, E. Fujisawa, S. Kimura, R. Saito, and T. Takayama.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 405-412, 1986. 8 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Aeration, Soil aeration, Bacteria, Air temperature, Soil temperature, Water temperature.

Soil-covered wastewater treatment systems have progressively been used during this decade both in the rural and urban areas in Japan. In order to evaluate the influences of extremely low air temperatures on the covered soil and sewage temperatures, the pressure of contact aeration tank and the treatment of wastewater, we compared the efficiencies of three types of contact aeration apparatus (sewage surface level, 30, 50, 70 cm from the soil surface; top shape of gravel layer, convex, flat; soil-sewage boundary, contact, separate) being packed with gravel as a contact medium and set in the temperature controlled test laboratory. At extremely low air temperatures, the covered soils and ice columns on the surface soils are important as a heat insulator. Freezing depths of soils were inversely correlated with sewage surface levels. The influences of soil freezing on the pressure of aeration tanks were negligibly small and thus soil freezing does not affect aeration systems. No significant changes in the sewage treatment functions among the three apparatuses were found. The soil covered wastewater treatment systems must be useful in cold districts. (Authors' abstract)
W88-03749

POSSIBLE UTILIZATION OF WASTE SLUDGE AS AN ABSORBENT FOR REMOVAL OF ORGANIC VAPOR,

National Taiwan Univ., Taipei.
P. C. Chang, and J. H. You.
Water Science and TEchnology WSTED4, Vol. 18, No. 7/8, p 413-420, 1986. 9 fig, 2 tab, 3 ref.

Descriptors: *Sludge, *Sludge utilization, *Organic solvents, Sludge disposal, Sludge solids, Organic compounds.

The waste sludge obtained from a municipal sewage treatment plant can be reclaimed as an adsorbent for the removal of organic vapors, i.e. toluene, methy-ethyl-ketone, and 112-trichloroethylene, through use of a pyrolysis technique. To find the optimum manufacturing process, several tests were performed under various conditions in which the addition of a catalyst, temperature control, and residence time in the furnace were considered as the three major factors. Both the reclaimed adsorbent and commercially available activated carbon were evaluated to determine their adsorption capacity at various influent concentrations of organic vapors. The maximum adsorption capacity (or surface area) of the reclaimed adsorbent was achieved by adding 5M ZnCl2 to the sludge and then heating at 550 C with nitrogen gas for 1 hr. The adsorption capacity of MEK, TOL or TCE on the reclaimed adsorbent has a strong correlation with its corresponding specific surface area. The adsorption capacity of the reclaimed adsorbent was found to be approximately 60-70% of that of the commercially activated carbon when the influent concentration of MEK, TOL, or TCE introduced was higher than 3,000 ppm. The adsorption capacity of the reclaimed adsorbent for organic vapors decreased in the sequence MEK > TCE > TOL and was strictly dependent on the corresponding polarity of the compounds. (Authors' abstract)
W88-03750

REFLECTIONS ON ANAEROBIC PROCESS BIOTECHNOLOGY AND ITS IMPACT ON WATER UTILISATION IN SOUTH AFRICA,

National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien, and J. P. Maree.

Water S. A. WASADV, Vol. 13, No. 3, p 137-144, July 1987. 6 fig, 2 tab, 65 ref.

Descriptors: *Wastewater treatment, *Anaerobic treatment, *Biological treatment, Salinization, Eutrophication, Nutrients, Anions, Sulfates, Nitrates, Phosphates.

Anaerobic processes that can be used for the prevention of salination, eutrophication, and organic pollution of water, are reviewed. Sulfate which contributes to the salination of surface water, can be converted under anaerobic conditions to H2S, from which sulfur can be recovered. The removal of phosphates and nitrates is essential to control eutrophication. An anaerobic stage plays an important role in all biological processes by which these elements are removed. Organic material, originating from domestic and industrial effluents, and sewage sludge, are increasingly being treated in anaerobic processes because of low energy costs. Various processes and reactor types being used for this purpose are discussed. (Author's abstract)
W88-03767

SUBSTRATE UTILISATION BY YEAST IN A SPENT SULPHITE LIQUOR PERMEATE,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
J. D. Streit, B. A. Prior, and S. G. Kilian.
Water S. A. WASADV, Vol. 13, No. 3, p 145-150, July 1987. 4 fig, 3 tab, 23 ref.

Descriptors: *Yeasts, *Wastewater treatment, *Sulfites, *Effluents, *Pulp wastes, *Ultrafiltration, *Substrates, Sugars, Acetic acid, Costs, Growth.

Spent sulfite liquor (SSL) is a waste effluent of the pulp industry. The refractory nature and high chemical oxygen demand (COD) of the effluent creates a serious pollution problem that is difficult and expensive to dispose of satisfactorily. Ultrafiltration of SSL (to recover chemicals), produced a permeate containing mainly D-xylose (22.5 g/L) and acetic acid (10.1 g/L). Candida utilis was most effective amongst a number of yeasts in the utilization of these substrates and its growth resulted in a 57% reduction of the COD. The inhibition of C. utilis growth by sulfite and acetic acid was alleviated by steam treatment and pH control of SSL. Yeast protein could be recovered from the SSL as a valuable by-product and may reduce the costs of final treatment of SSL before discharge into the environment. (Author's abstract)
W88-03768

PRELIMINARY OBSERVATIONS ON POLYHYDROXYBUTYRATE METABOLISM IN THE ACTIVATED SLUDGE PROCESS,
Johannesburg City Health Dept. Labs. (South Africa).
L. H. Lotter.
Water S. A. WASADV, Vol. 13, No. 3, p 189-191, July 1987. 1 fig, 2 tab, 18 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Polyhydroxybutyrates, Metabolism, Activated sludge, Sludge, Phosphorus removal, Nutrients, Anaerobic conditions, Substrates.

The synthesis and degradation of polyhydroxybutyrate in various zones of three activated sludge plants was monitored. Good phosphorus removal appeared to coincide with anaerobic synthesis of polyhydroxybutyrate. Sufficient substrate addition was essential for synthesis of polyhydroxybutyrate and subsequent phosphorus uptake. (Author's abstract)
W88-03775

RESULTS FROM GREAT LAKES POTW OPTIMIZATION PROJECT,
Environmental Protection Agency, Chicago, IL. Environmental Services Div.
D. H. Stoltenberg, and P. J. Horvatin.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 736-751, August 1987. 8 fig, 9 tab. EPA Contract 68-01-6495.

Descriptors: *Wastewater treatment, *Wastewater treatment facilities, *Optimization, *Great Lakes region, Operations, Evaluation, Costs, Construction.

In 1982, a United States Environmental Protection Agency contract to improve operation and maintenance at several major municipal wastewater treatment plants in the Great Lakes Region was completed by the consulting engineering firm McNamee, Porter, and Seeley of Ann Arbor, Michigan. The study was conducted in two parts: (1) Phase I, consisting of comprehensive evaluations at 30 major municipal plants experiencing problems, during which reports were written and recommendations were made for operational improvements; and (2) Phase II, consisting of composite correction programs at ten of the plants to actually implement the recommendations made in Phase I. The overall results of the project are summarized and the results of the composite correction programs instituted in Trenton, Michigan, Genesee County WWTP 2, Michigan, and Wapakoneta, Ohio, are highlighted. These examples of technical assistance clearly illustrate that significant improvement in operational efficiency can be made without major investments in capital construction. Significant results are achieved in terms of cost savings and phosphorus, BOD5, suspended solids, and ammonia nitrogen reductions. (Author's abstract)
W88-03794

NONCIRCULAR SEWER DESIGN,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-03799

TRANSIENT RESPONSES INCORPORATING PRODUCTS FORMATION,
Wisconsin Univ., Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and M.-D. Cheng.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 868-880, August 1987. 1 fig, 2 tab, 18 ref, append. EPA Competitive Research Program R808201.

Descriptors: *Wastewater treatment, *Biological treatment, *Model studies, *Metabolism, *Activated sludge, Equations, Biomass, Substrates, Microbiology, Effluents.

Applying the concept that microbes utilize the organic substances in the influent, generate metabolic products, and reutilize these products in a typical activated sludge system, a double substrate model is proposed. In this model, system dynamic equations on biomass, primary substrate, and metabolic products are developed. These equations relate the microbial kinetics and pertinent process variables. The developed model simulates the time-dependent responses of the effluent COD, residual primary substrate, and metabolic products in the effluent under step input loadings. (Author's abstract)
W88-03802

METHANE PRODUCTION USING A BIO-REACTOR PACKED WITH PUMICE STONE ON AN EVAPORATOR CONDENSATE OF KRAFT PULP MILL,
Tokyo Inst. of Tech. (Japan).
K. Minami, T. Horiyama, M. Tasaki, and Y. Tanimoto.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 6, p 523-532, December 1986. 10 fig, 4 tab, 9 ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Anaerobic digestion, *Methane production, *Kraft mills, *Biological wastewater treatment, Industrial wastes, Bioreactors.

When an evaporator condensate stream from a kraft mill was treated by anaerobic methane fermentation, the stream could not ferment continuously. Therefore, after the raw evaporator condensate was treated by various procedures, the treated samples were tested in a batch fermentation system. There seemed to be an inhibitor, an oily material, and the evaporator condensate could be fermentated easily, after removal of the oily material, in a bioreactor packed with pumice stone. In continuous operation, the minimum hydraulic retention time was 0.64 days, the maximum volumetric biological oxygen demand removal rate was 11.47 kg/cu m/day, and the maximum gas production rate for the theoretical volume was 97%. The efficiency of a bioreactor using pumice stone was studied. The pumice stone has a large number of connected pores. The major pore sizes are 20-100 micrometers. The cell density of the pumice stone used in the bioreactor was 18-19 gm/L. (Author's abstract)
W88-03810

EFFECTS OF WASTEWATER STRENGTH ON THE PERFORMANCE OF AN ANAEROBIC FILTER,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, M. Fujita, J. Qu, J. Zhang, and A. Yamazaki.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 6, p 545-551, December 1986. 10 fig, 2 tab, 6 ref.

Descriptors: *Wastewater treatment, *Pretreatment of wastewaters, *Anaerobic digestion, *Organic carbon, Biogas production, Biological wastewater treatment, Biological filters, Suspended solids, Retention time.

The effects of wastewater strength on the performance of an anaerobic filter were investigated with a bench-scale filter unit using both high and low strength synthetic wastewaters. The organic carbon removal and biogas production in high strength wastewater (3,000 mg/L of organic carbon) were always higher than in low strength wastewater (1,00 mg/L of organic carbon) when similar organic space loading rates were used. With high strength wastewater, washout suspended solids were less than those with low strength wastewater. The major factor which affected solids losses appears to be the hydraulic retention time. These solids losses caused a shorter sludge or biomass retention time in low strength wastewater and subsequently, in the lower organic removal efficiencies and gas production rates in contrast with high strength wastewater. (Author's abstract)
W88-03811

IMPROVEMENT OF SETTLING CHARACTERISTICS OF ACTIVATED SLUDGE BY ADDITION OF A FLOCK-FORMING BACTERIUM,
Hitachi Ltd., Ibaraki (Japan). Advanced Research Lab.
N. Shimizu, and Y. Odawara.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 6, p 571-576, December 1986. 5 fig, 4 tab, 10 ref.

Descriptors: *Bacteria, *Activated sludge process, *Wastewater treatment, *Biological wastewater treatment, *Wastewater, Flocculation, Biological oxygen demand, Flood-processing wastes, Sludge seeding.

A floc-forming bacterium, strain no. 5, which made very large and easily precipitated flocs, was added as seed sludge in a bench-scale aeration tank. About one week was required for production of activated sludge which could treat high biological oxygen demand wastewater at high biological oxygen demand loading while maintaining very good settling characteristics. The strain no. 5 was present at 3% of the activated sludge. The settling characteristics of the activated sludge were much improved when the strain no. 5 culture was added to either a bench-scale aeration tank or a large-scale deep aeration tank treating bean paste wastewater. (Ray-PTT)
W88-03812

ADSORPTION OF POLLUTANTS ON TO ACTIVATED CARBON IN FIXED BEDS,
Queen's Univ., Belfast (Northern Ireland). Dept. of

Chemical Engineering.
G. Mckay, and M. J. Bino.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 37, No. 2, p 81-89, 1987. 9 fig, 3 tab, 8 ref.

Descriptors: *Adsorption, *Activated carbon *Fixed beds, *Phenols, *Wastewater treatment, *Adsorption model, Model studies, Mathematical models, Chlorinated hydrocarbons, Mercury.

The adsorption of certain pollutants, namely phenol, p-chlorophenol, sodium dodecylsulfate and mercuric ions, on to activated carbon has been studied using fixed bed systems. There are three main methods of contacting in solid/liquid adsorption systems, namely batch, fixed bed and fluidized bed systems. In fixed bed adsorption the adsorption rate is determined on the basis of adsorption equilibrium (unfavorable, linear, favorable or completely irreversible) and the controlling mechanism (external film mass transport, internal pore diffusion, internal solid phase diffusion or longitudinal diffusion). One or more of these transport mechanisms may be rate controlling depending on the solute-adsorbent system. For an adsorbent such as activated carbon which is highly porous, both external transport and pore diffusion will be very important. An adsorption model, based on external mass transport and internal pore diffusion, was applied to the systems to predict theoretical breakthrough curves. These curves were then compared with experimental data and using a 'best fit' technique, an effective pore diffusion coefficient was determined for each sorbate-carbon system. (Author's abstract)
W88-03813

COMPLEX SEWERAGE JOB MOVING,
For primary bibliographic entry see Field 5G.
W88-03814

TREATED SEWAGE FINDS FRUITFUL USE,
For primary bibliographic entry see Field 3C.
W88-03815

ANALYSIS OF FULL-SCALE SBR OPERATION AT GRUNDY CENTER, IOWA,
Notre Dame Univ., IN.
R. L. Irvine, D. V. S. Murthy, M. L. Arora, J. L. Copeman, and J. A. Heidman.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 3, p 132-138, March 1987. 3 fig, 6 tab, 8 ref. EPA contract No. 68-03-1821.

Descriptors: *Sequential batch reactor, *Wastewater treatment, *Activated sludge process, *Biological wastewater treatment, *Intermittent cycle extended aeration system, Effluent quality, Grundy Center, Iowa, Design flow, Effluents, Sludge, Design criteria, Phosphorus removal, Nitrogen removal, Denitrification.

The wastewater treatment plant at Grundy center, Iowa was designed to operate as a periodic process rather than as a conventional continuous flow activated sludge system because of the successful operation of the Sequential Batch Reactor (SBR) at Culver, Ind. Because of the lack of many features necessary to operate in SBR mode the Grundy plant could not be operated in the true SBR fashion. As a result the effluent quality suffered occasionally. A series of plant modifications enabled the system to operate as a true SBR. During June - August of 1985 operating procedures were developed for producing high quality effluent. The influent flow rates throughout the development period (June - August 1985) averaged 80% of the design flow rates and the average detention time achieved was 75% greater than obtained for the full-scale SBR in Culver. The study concluded that: The system, modified to operate as an SBR, can also be used in ICEAS (intermittent cycle extended aeration system) mode, if necessary. Adequate organism settling characteristics can be developed for the SBR. Aeration time can be reduced by 20%. The method and time of energy input in terms of aeration is very important for system performance. Amount of sludge produced is also dependent on how and when energy is supplied to the system. Design criteria for periodic and different operating strategies used were not ideal for either denitrification or biological phosphorous removal; approximately 80% of the inorganic nitrogen and 50% of the phosphorous were removed in the system. (Ray-PTT)
W88-03829

EFFECTS OF TEMPERATURE, TIME, AND BIOMASS ON WET AIR REGENERATION OF CARBON,
CH2M/Hill, Denver, CO.
J. Ding, V. L. Snoeyink, R. A. Larson, M. A. Recktenwalt, and C. A. Wedeking.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 3, p 139-144, March 1987. 8 fig, 2 tab, 14 ref. EPA grants CR 806819 and CR 810462.

Descriptors: *Activated carbon, *activated sludge process, *Biological wastewater treatment, *Wastewater treatment, *Temperature effects, *Biomass, *Retention time, Adsorbents, Regeneration.

The effects of regeneration time, temperature, and the presence of biomass on the adsorption properties of regenerated powdered activated carbon (PAC), and on PAC loss during regeneration were studied. Virgin PAC and PAC loaded with a single adsorbate were regenerated in the presence and absence of biomass at different temperatures and regeneration times. The results show that as the regeneration temperature increases the adsorption capacity of regenerated PAC decreases. The effect of temperature is influenced by biomass and adsorbed compounds. Organic matters adsorbed on PAC necessitated the use of higher operation pressure to supply oxygen for the oxidation of organic compound adsorbed on PAC. However, the presence of biomass counteracts, significantly, the adverse effects of high temperature on PAC. Longer retention time also lowers the adsorption capacity of regenerated PAC. The loss of PAC mass and its adsorption capacity are due to the surface oxidation of PAC. Hence, control of regeneration temperature and time is necessary for proper operation. (Ray-PTT)
W88-03830

STATISTICAL ANALYSIS OF INDUSTRIAL WASTEWATER MONITORING DATA,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 7A.
W88-03831

ENHANCEMENT OF ANAEROBIC TREATMENT EFFICIENCY THROUGH PROCESS MODIFICATION,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. R. Harper, and F. G. Pohland.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 3, p 152-161, March 1987. 11 fig, 4 tab, 28 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Biological wastewater treatment, *Process optimization, *Hydrogen gas, *Reactor design, *Methane bacteria, Temnperature effects, Hydrogen ion concentration, Solids retention, Filters.

A recent surve showed that in North America anaerobic treatment faces resistance to full-scale implementation, especially to newly developed anaerobic filters and sludge bed reactors. While this trend may be partially caused by increased filter media costs and a need for recycle or granular sludge storage, this may also be because anaerobic treatment is considered an unstable process. Numerous attempts were made to reveal the causes of anaerobic process instability. These are: temperature and pH control, increased solids retention, elimination of known inhibitors, and the addition of nutrients. Recently, hydrogen has been recognized as an important process intermediate and several strategies for hydrogen control are under study. From studies comparing several anaerobic treatment systems, each unique in the management of gaseous end products (particularly hydrogen), it is concluded that differences in reactor configuration can produce differences in the hydrogen environment and the associated microbial characteristics and that these differences can be translated into advancements in process efficiency and stability. Efficient removal of hydrogen either by proper reactor configuration and operation or by the use of a downflow filter where hydrogen produced at the top is prevented from influencing the reaction, will promote stability and enhance efficiency of the process (Ray-PTT)
W88-03832

PLACE OF NONPOTABLE REUSE IN WATER MANAGEMENT,
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 3C.
W88-03850

MONITORING AND STUDY PROGRAM OF AN INTERREGIONAL WASTEWATER RECLAMATION SYSTEM FOR AGRICULTURE,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 3C.
W88-03851

FOAMING IN ANAEROBIC DIGESTERS - A SURVEY AND LABORATORY INVESTIGATION,
California Univ., Berkeley.
A. Niekerk, J. Kawahigashi, D. Reichlin, A. Malea, and D. Jenkins.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 5, p 249-253, May 1987. 4 fig, 2 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Biological wastewater treatment, *Foaming, *Activated sludge process, Filamentous microorganisms, Nocardia.

The literature on anaerobic digester foaming was reviewed and a survey conducted of digester foaming in California. The results of an experimental study showed that anaerobic digester foaming is associated with waste activated sludge in feed that contained the filamentious microorganism Nocardia. Anaerobic digester foaming intensity is a function of digester mixing methods. Mixing methods which introduce fine, gas bubbles into the digester enhance foaming. (Ray-PTT)
W88-03852

PILOT TESTING FOR COMBINED TREATMENT OF LEACHATE FROM A DOMESTIC WASTE LANDFILL SITE,
Dayton and Light Ltd., West Vancouver (British Columbia).
H. G. Kelly.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 254-261, May 1987. 1 fig, 5 tab, 15 ref.

Descriptors: *Water pollution treatment, *Water pollution prevention, *Leachate, *Sanitary landfills, *Combined treatment, *Activated sludge, Dissolved oxygen, Ammonia, Heavy metals, Pilot plants, Biological oxygen demand, Chemical oxygen demand.

Toxic springs that discharged to a fish-bearing stream were earmarked for collection and treatment by the District of Chilliwack, British Columbia, Canada. Preference was to combine the leachate for treatment in the District's activated sludge plant. To ensure the treatment plant would respond satisfactorily, a pilot test facility was constructed to compare combined treatment against a control, and four different test conditions were evaluated to determine: treatability in reducing biological oxygen demand and chemical oxygen demand; effects of ammonia from leachate on plant operations; effects of sludge production; and changes in heavy metal concentrations in the mixed liquor. Findings showed combined treatment is possible but dissolved oxygen uptake rates,

sludge production and heavy metals showed significant increases in the leachate test train compared to control train. White precipitates were also observed to coat the test train aeration tanks at study completion. (Ray-PTT)
W88-03853

COMPETITIVE GROWTH OF ZOOGLOEA RAMIGERA AND TYPE 021N IN ACTIVATED SLUDGE AND PURE CULTURE - A MODEL FOR LOW F:M BULKING,
Bruinette Kruger Stoffbert, Inc., Pretoria (South Africa).
A. M. Van Niekerk, D. Jenkins, and M. G. Richard.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 262-273, May 1987. 21 fig, 30 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Bulking sludge, *Bacteria, *Biological wastewater treatment, Microorganism growth, Filaments, Aerobic selectors, Substrates.

Experimental results are presented to explain why filamentous organisms such as Type 021N are selected in completely-mixed low food: microorganism systems and the mechanism by which selectors function to prevent filamentous organism growth and bulking at low food to microorganism ratios (F:M). The experiments include both activated sludge studies and pure culture work on a representative floc-forming bacterium and a filamentous bacterium (Type 021N) that cause bulking at low food to microorganism ratio. At low F:M (F:M=0.2 to 0.3 gm COD/g MLVSS.d) aerobic selector and sequencing batch reactor (SBR) activated sludge systems produce better settling basins. Aerobic selector systems were only successful in controlling bulking over a narrow range of sleictor sizes. It is concluded that sleiector systems can be designed on the basis of experiments using fill-and-draw systems. However, using batch pilot plant activated sludge experiments for the design of activated sludge systems that will ahve well-mixed aeration basins will give highly optimistic estimate of both the sludge settling and the organic matter removal rate characteristics. (Ray-PTT)
W88-03854

RECYCLING TO REDUCE SEDIMENT DISCHARGE IN PLACER MINING OPERATIONS,
Alaska Univ., Anchorage.
R. A. Johnson, J. H. Chapman, and R. M. Lipchak.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 274-283, May 1987. 12 fig, 3 tab, 27 ref. USGS Grant No. 14-08-0001G-1002.

Descriptors: *Mining drainage, *Wastewater treatment, *Pretreatment, *Sedimentation basin, *Settleable solids, Suspended solids, Turbidity, Alaska, Sediment load, Recycling.

Without effective treatment to remove particulate matter from process waters, gold placer mining operations can cause discharge of unacceptable high sediment loads to receiving waters. A 2-gal/min test loop was used to study the potential of recycling technology to reduce the discharge of particulates simulating an actual recycle operation. Two different configurations were tested using paydirt with clay content varying from 2 to 6% with up to 12 recycles. In all cases, > 90% of the total suspended solids in the feed was removed during each recycle, and the levels of total suspended solids remaining stabilized after several recycles. However, the recycled water had turbidity levels ranging from several hundred to several thousand NTUs. Hence, additional treatment would normally be required before discharge to Alaskan waters. The configuration using two sedimentation basins at a low flow rate had effluent total suspended solids an order of magnitude less than the configuration with just one basin. (Author's abstract)
W88-03855

REGIONAL INFILTRATION/INFLOW STUDY SOLVES WET WEATHER SEWER PROBLEMS,
East Bay Municipal Utility District, Oakland, CA.
W. J. Bishop, D. M. Diemer, and M. J. Williams.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 289-293, May 1987. 10 fig.

Descriptors: *Lateral sewers, *Infiltration, *San Francisco, *Storm water, *Sewer infiltration, *Storm sewers, Rainfall infiltration.

The 5-year, $16.5 million cooperative regional East Bay Infiltration/Inflow sanitary sewer system was studied and a low cost solution to excessive flow problems developed. Only 10% of peak wet weather flow is inflow and 90% is rainfall derived infiltration. Lateral sewers are a major cause of the problem and carry > 60% of peak flows. The recommended 20-yr community correction program will: rehabilitate 47% of the collection system at a cost of $190 million; construct 134 km of relief sewers at a cost of $125 million; and rehabilitate all defective laterals within the subareas designated for rehabilitation at a cost of $110 million. At the same time, the district will spend $145 million on its regional wet weather facilities to accommodate peak flows an protect beneficial uses in San Francisco Bay. (Ray-PTT)
W88-03857

CHARACTERIZATION, RENOVATION, AND UTILIZATION OF WATER FROM SLURRY TRANSPORT SYSTEMS,
Missouri Univ.-Columbia. Dept. of Chemistry.
S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183216/AS. Price codes: A02 in paper copy, A01 in microfiche. Missouri Water Resources Research Center Technical Completion Report, Columbia. September 30, 1982. 19 p, 6 fig, 3 tab, 10 ref. Contract No. 14-34-001-1241. Project No. OWRT B-148-MO.

Descriptors: *Wastewater treatment, *Water reuse, *Water treatment, *Coal, Adsorption, Activated carbon, Slurries, Reclaimed water, Ash, Heavy metals, Metals, Zinc, Cadmium, Lead, Copper, Nickel, Organic compounds, Industrial wastewater.

Laboratory studies indicate that water of impaired quality could be purified en route in a coal slurry pipeline, taking advantage of the long contact time and high mixing rate. Upon arrival at a powerplant the slurry would be burned, destroying the organics or retaining them with the coal ash. Purified water could be reclaimed. A coal gasification apparatus was used to prepare water contaminated with organic byproducts, nonactivated char, and coal ash. Removals of heavy metals (Cu, Ni, Pb, Cd, and Zn) were greatest (94-100%) with aged coal (surface oxidized). Other substances in decreasing order of contaminant adsorption were fresh coal, nonactivated char, activated char with coal humic substances, and activated char. Addition of these materials to a coal slurry would enhance adsorption of organics. (Cassar-PTT)
W88-03934

STABILISATION, DISINFECTION AND ODOUR CONTROL IN SEWAGE SLUDGE TREATMENT: AN ANNOTATED BIBLIOGRAPHY COVERING THE PERIOD 1950-1983,
Water Research Centre, Stevenage (England).
E. S. Connor.
Ellis Horwood Ltd., Chichester, England. 1984. 292 p.

Descriptors: *Bibliographies, *Sludge digestion, *Disinfection, *Wastewater treatment, *Odor control, Anaerobic digestion, Digestion, Aerobic digestion, Lime, Composting, Irradiation, Activated sludge, Pathogens, Viruses, Bacteria, Parasites, Fate of pollutants, Land disposal, Hydrogen sulfide, Sludge disposal, Solid waste.

A bibliography of 870 papers on sewage sludge treatment is divided into three major sections: stabilization (719 papers), disinfection, and odor control. Subjects covered under stabilization are anaerobic digestion, aerobic digestion, lime stabilization, and composting (without bulking agents, with bulking agents, with municipal refuse, and with worms). Disinfection techniques include irradiation, pasteurization, and chemical treatment. The fates of pathogens such as bacteria, viruses, and parasites during sludge treatment are explored. Among the substances used for control of hydrogen sulfide and other sludge odors are ozone, caustic soda, hydrogen peroxide, air dilution, ferric chloride, ammonia, calcium cyanamide, secondary effluent scrubbing, compost, and activated carbon. An author index and a subject index provide access to the annotations, which are arranged alphabetically by author within each section. (Cassar-PTT)
W88-03950

MODELLING IN THE TECHNOLOGY OF WASTEWATER TREATMENT,
Hungarian Post-graduate Training Inst., Budapest.
I. Horvath.
Pergamon Press, Oxford, England. 1984. 202 p.

Descriptors: *Wastewater treatment, *Model studies, *Scale, *Design criteria, *Hydraulics, Primary wastewater treatment, Screens, Settling basins, Turbulent flow, Filters, Chemical treatment, Flocculation, Clarifiers, Activated carbon, Adsorption, Extraction, Disinfection, Biological wastewater treatment, Trickling filters, Aeration, Activated sludge process, Contact filters, Sludge digestion, Mixing, Flow, Sludge thickening, Economic aspects, Kinetics, Mass transfer.

Scale-up methods, similarity theory approaches, and dimensional analysis are applied to problems of wastewater treatment. Subjects included are primary treatment (screens, sand traps, settling basins and filters), chemical treatment (flocculators, clarifiers, activated carbon adsorption, extraction equipment, elutriation, and disinfection), biological treatment (trickling filters, aeration tanks and rotating disc biological equipment), sludge treatment (digesters and thickeners), applications to the activated sludge process, and economic aspects. It was concluded that the technological processes in wastewater treatment systems can be scaled up with a fair degree of approximation by taking the main operational variables and parameters into account. Results of model studies alone can be misinterpreted. For example, in scaling up activated sludge systems it is essential to ensure identical times, loads/unit volume, concentrations, temperatures, and reactivity conditions in the different scales. (Cassar-PTT)
W88-03951

DICTIONARY OF WASTE AND WATER TREATMENT,
National Coal Board, London (England).
J. S. Scott, and P. G. Smith.
Butterworths, London. 1981. 359 p.

Descriptors: *Wastewater treatment, *Water treatment, *Dictionaries, Waste disposal, Sewer systems, Water supply, Water pollution prevention.

A comprehensive dictionary contains 6000 terms used in water treatment and supply, sewerage, sewage treatment and disposal, solid waste disposal and reclamation, pollution prevention, and toxic and hazardous waste disposal. Terms used in the United Kingdom and United States are included. Process design data and illustrations are presented where relevant. (Cassar-PTT)
W88-03982

DEVELOPMENT OF DESIGN AND OPERATIONAL CRITERIA FOR WASTEWATER TREATMENT,
AWARE, Inc., Nashville, TN.
C. E. Adams, D. L. Ford, and W. W. Eckenfelder.
Enviro Press, Inc., Nashville, TN. 1981. 493 p.

Descriptors: *Wastewater treatment, *Design criteria, *Biological wastewater treatment, Wastewater analysis, Sampling, Coagulation, Chemical precipitation, Sedimentation, Flotation,

Mixing, Oxygen transfer, Aeration, Activated sludge process, Aerated lagoons, Trickling filters, Stabilization ponds, Anaerobic digestion, Filtration, Activated carbon, Adsorption, Oxidation, Ozonation, Sludge thickening, Digestion, Centrifugation, Ion exchange, Chlorination.

Test procedures required for formulation and optimization of wastewater plant design or for optimizing the operation of an existing facility are presented. The transition from small-scale to full-scale is discussed. The limitations and considerations in applying experimental data to full-scale design and operation are emphasized. Topics included in this book, written for design engineers, treatment plant operators, laboratory personnel, and students, include the following: wastewater characterization, sampling techniques, screening for wastes toxic to the system, pH adjustment within the process and before discharge into receiving water, coagulation, and precipitation, sedimentation, dissolved air flotation, hydraulics and mixing, oxygen transfer and aeration equipment, the activated sludge process, aerated lagoons, trickling filters, waste stabilization ponds, anaerobic treatment, granular media filtration, activated carbon adsorption, ion exchange, chemical oxidation (chlorination and ozonation) of effluents, gravity sludge thickening, sludge digestion, vacuum filtration, centrifugation, pressure filtration, air drying of sludges, thermal content of sludges, and sludge recovery. (Cassar-PTT)
W88-03985

ADVANCED BIOLOGICAL TREATMENT OF MUNICIPAL WASTEWATER THROUGH AQUACULTURE,
Oklahoma State Dept. of Health, Oklahoma City.
D. H. Hall, and J. E. Shelton.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-159319. Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-83-007, January 1983. 80 p, 3 fig, 7 tab, 9 ref, 5 append. Contract No. R-803703.

Descriptors: *Wastewater treatment, *Aquaculture, Biological treatment, Fish, Fathead minnows, Stabilization ponds, Suspended solids, Nutrients, Advanced wastewater treatment, Ponds, Lagoons, Secondary wastewater treatment, Wastewater lagoons.

Two four-celled raceways constructed in series adjacent to a primary wastewater stabilization pond were used as aquaculture facilities for advanced treatment of municipal wastewater. One raceway functioned as the experimental system, while the other served as control. The two experimental phases were as follows: condition-1, which used a source of wastewater from the primary wastewater stabilization pond, and condition-2, which used a source of wastewater from the primary clarifier of an activated sludge treatment plant. The raceways were stocked with a native Oklahoma fish, fathead minnow, at two stocking densities, one for each experimental phase. In condition-1 phase the fish produced moderate reductions in suspended solids but no distinguishable reductions in BOD or nutrients. In the condition-2 experiment no impact on wastewater quality was observed. High mortality of fish was observed in this system, which had limited dissolved oxygen. It was concluded that aquaculture with these fish is practical as an adjunct to the wastewater stabilization pond but is not suitable as a secondary treatment method. (Cassar-PTT)
W88-03988

ORTHOPHOSPHATE REMOVAL FROM A SYNTHETIC WASTEWATER USING LIME, ALUM, AND FERRIC CHLORIDE,
Alabama Dept. of Environmental Management, Montgomery.
L. Sisk, L. Benefield, and B. Reed.
Separation Science and Technology SSTEDS, Vol. 22, No. 5, p 1471-1501, May 1987. 15 fig, 5 tab, 12 ref.

Descriptors: *Wastewater treatment, *Phosphate removal, *Orthophosphates, *Lime, *Alum, *Ferric chloride, Chemical precipitation, Hydrogen ion concentration, Mathematical studies, Regression analysis.

Lime, alum, and ferric chloride were evaluated using a series of jar tests to determine their effectiveness in orthophosphate precipitation from synthetic wastewaters. Calcium phosphate precipitation was most efficient at pH 11.0 and a total carbonate to phosphorus, C sub tau:P, molar ratio of 15.0. For these conditions, a residual total orthophosphate concentration of 0.12 mg/liter P was observed. The Mg:P molar ratio had little effect on orthophosphate removal from the synthetic wastewater. When alum was used, the minimum residual total orthophosphate concentration observed was 0.21 mg/liter P for an Al:P molar ratio of 3.0 and a pH of 6.0 when pH was adjusted before and during alum addition. When ferric chloride was used, it was found that an Fe:P molar ratio of 3.0 and a pH of 6.0 resulted in the lowest residual total orthophosphate concentration. This value was 0.19 mg/liter P when pH was adjusted before and during iron addition. A multiple regression analysis produced mathematical relationships which can be used to predict residual soluble and residual total orthophosphate concentration for lime, alum, and ferric chloride treatment. (Author's abstract)
W88-04001

CHEMISTRY OF HEAVY METALS IN DIGESTED SEWAGE SLUDGE - I. COPPER (II) COMPLEXATION WITH SOLUBLE ORGANIC MATTER,
Oxford Univ. (England). Dept. of Agricultural Science.
P. Fletcher, and P. H. T. Beckett.
Water Research WATRAG, Vol. 21, No. 10, p 1153-1161, October 1987. 9 fig, 1 tab, 38 ref.

Descriptors: *Heavy metals, *Chemical analysis, *Sludge, *Wastewater treatment, *Copper, *Organic matter, Chemical reactions, Cation exchange, Hydrogen ion concentration, Anions, Model studies.

Characteristics of copper-binding, in the soluble fraction of a digested sewage sludge were determined using ion-selective electrodes. Results showed that ion exchange with protons is a principal component in copper binding and that the soluble organic matter has a cation exchange capacity of 3.86 m-equiv/gm at pH 6.5. A pH-dependent exchange constant, defined in terms of mole fractions of exchange components, describes the data in the pH range 2-8 and is independent of both pH and the extent of exchange in the range 5.5-8. Supplementary data include acid/base titration curves and simple kinetic measurements. Anion uptake, is insignificant in the pH range, 2.5-7. A model of the aqueous phase of a sewage sludge containing soluble organic matter with only copper and protons as competing ions predicts that at pH 7 > 99% of the copper present will be bound to the soluble organic matter. (See also W88-04018) (Author's abstract)
W88-04017

CHEMISTRY OF HEAVY METALS IN DIGESTED SEWAGE SLUDGE - II. HEAVY METAL COMPLEXATION WITH SOLUBLE ORGANIC MATTER,
Oxford Univ. (England). Dept. of Agricultural Science.
P. Fletcher, and P. H. T. Beckett.
Water Research WATRAG, Vol. 21, No. 10, p 1163-1172, October 1987. 11 fig, 4 tab, 14 ref.

Descriptors: *Heavy metals, *Chemical analysis, *Sludge, *Wastewater treatment, *Organic matter, *Chemical reactions, *Complexation, Calcium, Magnesium, Copper, Cobalt, Nickel, Zinc, Manganese, Lead, Iron, Ion exchange, Hydrogen ion concentration.

Some characteristics of the binding of the ions Ca(II), Mg(II), Cu(II), Co(II), Ni(II), Zn(II), Mn(II), Pb(II) and Fe(II) on the soluble organic matter in a digested sewage sludge were determined using ion-selective electrodes. Results showed that ion exchange with protons is a principal component in metal binding and that Cu and Pb can replace more protons from the soluble organic matter than can the other ions. It appeared that the soluble organic matter contained two distinguishable groups of exchange sites. One group of sites was capable of binding all of the above ions plus protons, whereas the second set could bind Cu(II), Pb(II) and protons only. A numerical description of their uptake characteristics, based on two sets of ion exchange constants for each element, was able to predict the measured values of cation activity to within + or - 10% in the pH range 5.7-7. This thermodynamic data was in reasonable agreement with the general concepts of coordination chemistry. The concentrations of Ca and Mg in sewage sludge are high enough to compete so strongly with other metal ions that only Cu, Pb and Cd will be bound significantly. Consequently, the model was simplified to predict the ion uptake behavior of soluble organic matter in the presence of high concentrations of Ca using a limited set of analytical expressions (analogous to adsorption equations) rather than the complete set of equilibrium constants. (See also W88-04017) (Author's abstract)
W88-04018

COMBINED EFFECT OF CARBON DOSAGE AND INITIAL ADSORBATE CONCENTRATION ON THE ADSORPTION ISOTHERM OF HEAVY METALS ON ACTIVATED CARBON,
National Univ. of Singapore. Dept. of Chemical Engineering.
T. C. Tan, and W. K. Teo.
Water Research WATRAG, Vol. 21, No. 10, p 1183-1188, October 1987. 7 fig, 2 tab, 17 ref.

Descriptors: *Activated carbon, *Water treatment, *Adsorption, *Heavy metals, *Wastewater treatment, *Mathematical analysis, Hydrogen ion concentration, Chromium, Lead, Carbon, Langmuir equation, Freundlich equation, Mathematical equations, Mathematical studies.

The adsorption of dissolved chromium and lead ions by powdered activated carbons significantly depends on the pH, initial adsorbate concentration and carbon dosage. Freundlich and Langmuir equations were unable to describe adequately the observed isotherms under the combined influence of both the carbon dosage and initial adsorbate concentration. These equations were modified, and the resulting equations correlated well with the experimental equilibrium data. The modified Langmuir equation gave an overall mean ratio of calculated to experimental adsorptive capacity of 1.001 compared with 1.046 given by the modified Freundlich equation for a total of 135 sets of equilibrium data obtained at different carbon dosages and initial adsorbate concentrations. (Author's abstract)
W88-04020

FATE OF HEAVY METALS IN WASTEWATER STABILIZATION PONDS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Lab. for Environmental Applied Microbiology.
D. Kaplan, A. Abeliovich, and S. Ben-Yaakov.
Water Research WATRAG, Vol. 21, No. 10, p 1189-1194, October 1987. 5 fig, 4 tab, 22 ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Wastewater treatment, *Stabilization ponds, Zinc, Calcium, Lead, Copper, Anodic stripping voltammetry, Chemical analysis, Solubilization, Municipal wastewater, Simulation analysis, Toxicity, Chlorella.

The distribution of toxic heavy metals was studied throughout the process of treatment of domestic wastewater by stabilization ponds. The concentrations and distribution of free and bound zinc, cadmium, lead and copper through the various stages of a treatment plant were analyzed by Anodic Stripping Voltammetry (ASV). Only a slight decrease in the total metals concentration was observed during the various stages of the wastewater treatment plant. However, the distribution among dissolved (free and chelated) and particulate fractions did change towards stabilization of most of the particulate fraction. Within the soluble fraction a significant decrease in the free cations occurred

due to a proteinaceous chelating agent(s) released by the microbial population in the ponds. A similar phenomenon was found in simulated laboratory experiments which were carried out with a Chlorella strain isolated from the stabilization ponds. (Author's abstract)
W88-04021

REMOVAL OF NITROGEN, PHOSPHORUS AND COD FROM WASTE WATER USING SAND FILTRATION SYSTEM WITH PHRAGMITES AUSTRALIS,
Tohoku Univ., Sendai (Japan). Biological Inst.
A. G. Wathugala, T. Suzuki, and Y. Kurihara.
Water Research WATRAG, Vol. 21, No. 10, p 1217-1224, October 1987. 8 fig, 4 tab, 26 ref. Japan Ministry of Education, Culture and Science Grant No. 58030003.

Descriptors: *Wastewater treatment, *Nitrogen removal, *Phosphorus removal, *Chemical oxygen demand, *Filtration, *Phragmites australis, Sand, Biological wastewater treatment, Nitrogen, Phosphorus, Biomass.

The removal efficiencies of nitrogen, phosphorus, and COD from wastewater were examined using sand filtration systems with Phragmites australis (Cav.) Trin. ex. Steudel. The quality of effluent waters from the system with plant were far better than those from the one without plant, implying that Phragmites could incorporate nitrogen and phosphorus into its tissues and promote phosphorus absorption onto the sand by the release of oxygen from the roots. The pot provided with influent containing 198 mg/L of total N and 21 mg/L of total P had the highest biomass of Phragmites. Harvestable above-ground biomass accounted for about 3.5 kg/sq m and removable N and P accounted for 69 and 6 g/sq m respectively. The removal rates of total N and P in the system with Phragmites receiving variable amounts of COD were almost at the same level and also much better than those of the systems without plant, implying that the different COD concentrations in the influent media do not impair the removal efficiencies of N and P. Phragmites was resistant to COD concentrations as high as 128 mg/L. Signs of clogging were not detected in this system throughout the experiment. (Author's abstract)
W88-04024

BIODEGRADABILITY OF OZONATION PRODUCTS AS A FUNCTION OF COD AND DOC ELIMINATION BY EXAMPLE OF SUBSTITUTED AROMATIC SUBSTANCES,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. Wassertechnologie.
E. Gilbert.
Water Research WATRAG, Vol. 21, No. 10, p 1273-1278, October 1987. 10 fig, 1 tab, 22 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Biodegradation, *Ozonation, *Chemical oxygen demand, *Organic carbon, Chemical reactions, Aromatic compounds, Biological oxygen demand, Hydrogen ion concentration.

Ozone pretreatment studies of nonbiodegradable substituted aromatic compounds were conducted to evaluate the effects of ozonation on the biodegradability of the oxidation products as a function of COD- DOC-elimination and ozone consumption. In the case of substituted aromatic compounds, a 60-70% decrease of the COD-value and a 30-40% decrease of the DOC-value lead to biodegradable products (BOD5/COD=0.4) independent of the pH and the initial concentration of compounds. To reach good biodegradability of the oxidation products an average of 3 mg ozone/l mg initial DOC is necessary. (Author's abstract)
W88-04031

IMPACT OF ROTIFER GRAZING ON POPULATION DYNAMICS OF GREEN MICROALGAE IN HIGH-RATE PONDS,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
M. Schluter, J. Groeneweg, and C. J. Soeder.
Water Research WATRAG, Vol. 21, No. 10, p 1293-1297, October 1987. 5 fig, 19 ref.

Descriptors: *Wastewater treatment, *Rotifers, *Population dynamics, *Ecological effects, *Algae, *Grazing, *Ponds, Species diversity, Aquatic environment, Ecosystems, Bacteria.

In high-rate algal ponds used for wastewater treatment, the grazing activity of rotifers such as Brachionus rubens or B. calyciflorus often leads to a replacement of Scenedesmus species by Micractinium pusillum. In contrast to many other green microalgae including Scenedesmus, Micractinium pusillum with fully developed spines (setae) cannot be eaten by Brachionus. Ecological conditions for population shifts between Scenedesmus and Micractinium are therefore interpreted as a response of the rotifers rather than being due to physiological properties of the algae. Another effect of rotifer grazing on the microbial flora of high-rate ponds is the development of large stable flocs consisting of bacteria and microalgae. (Lantz-PTT)
W88-04034

EXPERIMENTAL AND NUMERICAL ANALYSES OF PERCHED GROUNDWATER MOUNDS BELOW SEPTIC SYSTEMS,
Oak Ridge National Lab., TN.
G. V. Wilson, H. D. Scott, and L. D. Wills.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 843-850, July-August 1987. 7 fig, 1 tab, 35 ref.

Descriptors: *Wastewater treatment, *Solid disposal fields, *Soil water, *Groundwater, *Perched water, Groundwater movement, Kriging, Water pressure, Soil water properties, Mathematical analysis, Mathematical models, Permeability coefficient, Finite element method.

Previous models for perched groundwater mounds have not been verified with in situ measurements. A septic tank filter field system consisting of a triple line source was installed in a Captina silt loam (Typic Fragiudult). The soil has a fragipan at the ~0.7 m depth with a wavy, irregular boundary. Tensiometers were used to monitor the temporal and spatial distributions of soil water potential. The results revealed that steady-state soil water conditions existed during spring and fall. Soil water pressure potentials at unmeasured locations were kriged from in situ data with quadratic drift removed using universal kriging. The kriged pressure potentials were contoured resulting in equipotential lines, with the zero equipotential line representing the water table. The Laplace equation in two dimensions, including a source term, appropriate for these flow conditions, was solved using a Galerkin finite element technique. Contours of equal pressure potential predicted by the model for various flow conditions were obtained. The two-dimensional simulation model was verified with the in situ data by overlaying the contour graphs of the kriged values with the model's predicted values. The effect of highly variable saturated hydraulic conductivity on the model's prediction was also investigated. The finite element model adequately predicted the depth of the water table as well as the range in equipotential lines and their locations when based on the mean saturated hydraulic conductivity. Therefore, the finite element model can be considered acceptable for modeling a perched water table below septic systems under steady-state conditions. (Lantz-PTT)
W88-04037

USE OF GASEOUS OZONE IN TREATMENT OF INDUSTRIAL WASTEWATER CONTAMINATED BY AZO-DYES,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
G. El Diwani, A. I. Hafez, and S. Hawash.
Chemie-Ingenieur-Technik CITEAH, Vol.59, No. 8, p 653-654, 1987. 3 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Ozonation, *Azo dyes, Dyes, Industrial wastewater, Oxidation, Color removal.

The effluent emitted by a textile plant contains waste fibers, washing and wetting agents, dispersed and dissolved dyestuffs, sizing residues and the like. A large part of the impurities in the water can be removed by conventional means, such as flocculation and/or biological treatment. Pilot tests were run on the use of ozone for decolorizing wastewater from dye works. The study results indicate that: (1) ozone treatment is effective for removal of color due to azo-dyes; (2) in a typical synthetic solution of p-Toluidine azo-dye, 10 mg/L of ozone removed 10% of color; and (3) the effect of contact time between ozone and dye is represented by the rate equation. The reaction is considered to be of pseudo first order. The specific reaction rate is 0.07887 mol/min and the slight deviation between the specific reaction rates arises because the reaction follows another regime during the injection of gaseous ozone. (Lantz-PTT)
W88-04053

MATHEMATICAL MODELING OF AN OZONE-AZO-DYE REACTION SYSTEM,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
G. El Diwani, A. I. Hafez, and S. Hawash.
Chemie-Ingenieur-Technik CITEAH, Vol.59, No. 8, p 654-656, 1987. 3 fig, 8 ref.

Descriptors: *Ozonation, *Mathematical models, *Azo dyes, *Wastewater treatment, Dyes, Color removal, Mass transfer, Decomposition, Mathematical equations.

The two-resistance theory applies to the process of mass transfer of ozone from gas to water. In a previous publication the ozone mass transfer rate was represented in terms of mass transfer coefficient based on overall driving force. The overall ozone reaction comprises its decomposition and chemical reaction. The autodecomposition and chemical reaction of ozone in an alkaline p-toluidene azo dye solution can be described reasonably well by a first order reaction. A mathematical model is proposed which provides a fairly good description of mass transfer behavior in the reactor. It can be used for process design under reaction conditions close to those studied. (Lantz-PTT)
W88-04054

ACTIVATED SLUDGE CLARIFIERS: DESIGN REQUIREMENTS AND RESEARCH PRIORITIES,
Montgomery (James M.), Inc., Pasadena, CA.
R. J. Tekippe, and J. H. Bender.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 865-870, October 1987. 2 fig, 32 ref.

Descriptors: *Activated sludge, *Clarifiers, *Design standards, *Research needs, *Wastewater treatment, Suspended solids, Clarification, Secondary wastewater treatment, Sludge.

A literature review of 320 references was conducted in an EPA-funded project to identify the needs for further research on activated sludge clarifier design and performance. The findings were summarized in a report and used as a basis of a 3-day research needs symposium. Some of the 14 research priorities generated by the symposium participants include: development of rating curves based on effluent TSS vs several key parameters, e.g., overflow rate, depth, solids loading; study of the frequency and occurrence of peak flows and short-term transients; application of foreign clarification technologies to U.S. plants; and study of the shear characteristics of clarifier inlet structures and their effect on flocculation. Recommendations for the conduct of such research. The latter includes protocol, roles of various organizations, and minimum sizes of facilities to require to secure meaningful data. (Author's abstract)
W88-04068

ASSESSMENT OF DESIGN TRADEOFFS WHEN USING INTRACHANNEL CLARIFIERS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. H. Bender.

Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 871-876, October 1987. 9 fig, 12 ref.

Descriptors: *Wastewater treatment, *Design standards, Clarifiers, Intrachannel clarifiers, Sludge, Mixed liquors, Aeration, Costs, Clarification, Oxidation.

Basic operation concepts for proprietary intrachannel clarifiers, the design considerations and benefits of systems without conventional secondary clarifiers are provided. Waste sludge concentrations, handling facilities sizes, circulating mixed liquor flow in oxidation ditches, aeration equipment and channel velocities, and the operation and maintenance considerations are included. The conclusion that oxidation ditch processes can be made more cost effective is supported. (Author's abstract)
W88-04069

DEVELOPMENT OF A DYNAMIC AERATED LAGOON MODEL,

Weyerhaeuser Research/Engineering, New Bern, NC.
R. W. Sackellares, W. A. Barkley, and R. D. Hill.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 877-883, October 1987. 3 fig, 3 tab, 22 ref.

Descriptors: *Wastewater treatment, *Aerated lagoons, *Computer programs, *Model studies, *DYLAMO, Stabilization ponds, Biological oxygen demand, Simulation analysis, Ammonia, Orthophosphate, Dissolved oxygen, Suspended solids.

DYLAMO, is an interactive computer program that is capable of simulating the steady state and dynamic behavior of completely or partially mixed aerated lagoons, including benthal zone interactions. The basis for the model's ability to simulate the internal and effluent concentrations of BOD, ammonia, orthophosphate, DO, and VSS is provided. Since 1982 the model has been used successfully at two mills to evaluate various engineering options including: increasing aeration, baffling, equalizing influent loads, dredging, adding supplemental nutrients, and changing the in-mill process to reduce BOD and hydraulic loadings. Because the model is capable of dynamic simulations, it is possible to simulate the impacts of chemical spills from spent liquors upon treatment system performance. It is doubtful that these assessments would have been possible by previously available engineering methods. (Author's abstract)
W88-04070

CONVERSION OF MUNICIPAL SLUDGE TO OIL,

Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
K. M. Lee, P. Griffith, J. B. Farrell, and A. E. Eralp.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 884-889, October 1987. 8 fig, 5 tab, 11 ref.

Descriptors: *Municipal wastewater, *Sludge, *Oil, *Wastewater treatment, Chemical treatment, Waste recovery, Temperature, Energy.

Thermal conversion of primary and secondary municipal sludge to oil using water as a solvent in a batch mode was evaluated. An oil separation procedure was developed. The oil obtained after thermal conversion was dark brown, solid at room temperature and liquid at above 50 C, with an average heat content of 9400 cal/g oil. Oil mass and energy yield increases were 73 and 67% in the primary sludge, and 515 and 485% in the secondary sludge, respectively, all with 10.9% volatile solids content. Catalyst addition did not increase the oil mass and energy yields. Data showed that primary sludge produces more oil, energy, and less by-product than secondary sludge in the thermal conversion process. (Author's abstract)
W88-04071

ORGANIC HALIDE AND ORGANIC CARBON DISTRIBUTION AND REMOVAL IN A PULP AND PAPER WASTEWATER LAGOON,

Arizona Univ., Tucson. Dept. of Civil Engineering.
C. W. Bryant, G. L. Amy, and B. C. Alleman.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 890-896, October 1987. 7 fig, 5 tab, 28 ref.

Descriptors: *Organic compounds, *Wastewater treatment, *Halides, *Organic carbon, *Pulp and paper industry, *Wastewater lagoons, Pulp wastes, Chorine, Chlorination.

The molecular weight distributions of total organic halide (TOX) and organic carbon (TOC) throughout an aerated lagoon treating a pulp and paper waste water, is described. The use of chlorine in the pulp bleaching process leads to the formation of chlorination byproducts ranging from simple identifiable compounds to chlorolignins. These compounds have been shown to exhibit toxic and mutagenic properties. Influent TOX levels approaching 60,000 micrograms/L were observed during the sampling program. An analysis of lagoon performance indicated approximate removals of one-third and one-fourth of the TOX and TOC, respectively. (Author's abstract)
W88-04072

CAPACITY OF A SWAMP FOREST TO ASSIMILATE THE TOC LOADING FROM A SUGAR REFINERY WASTEWATER STREAM,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. P. Gambrell, R. A. Khalid, and W. H. Patrick.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 897-904, October 1987. 2 fig, 8 tab, 10 ref.

Descriptors: *Swamps, *Wetlands, *Forests, *Water pollution effects, *Organic carbon, *Industrial wastewater, *Wastewater treatment, Land disposal, Water quality.

An investigation was carried out to determine the potential impact of a sugar refinery effluent on a receiving swamp and the nearby Blind River in southern Louisiana. The study included field investigations to determine the rate and direction of water flow and organic carbon levels in the receiving swamp, and laboratory studies to determine the rates of organic degradation in the swamp sediment-water system. Laboratory column studies were conducted on the swamp sediments as were aerial photographic and dye tracer observations of the wastewater in the swamp. Based on the results, the climatic conditions, and the refinery discharge volume, it is suggested that 80 to 160 ha of swamp area is needed to completely degrade the organic carbon loading from the refinery if a 15- to 30-cm water depth is maintained for 8 days. (Author's abstract)
W88-04073

CONTROL OF NOCARDIA SCUM IN ACTIVATED SLUDGE BY PERIODIC ANOXIA,

Pirnie (Malcolm), Inc., White Plains, NY.
J. A. Gasser.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 914, October 1987.

Descriptors: *Activated sludge, *Nocardia, *Microbial degradation, *Wastewater treatment, Dissolved oxygen, Aeration, Temperature, Anoxia.

Control of scum was achieved by shutting off all of the aerators in each basin for predetermined periods. This caused the DO to drop to an immeasurable concentration within a minute or two and created a temporary 'anoxic selector' (a basin in which nitrate nitrogen is available as an electron acceptor, favoring the growth of floc-forming bacteria over filamentous forms). The various process conditions which controlled scum are summarized as follows: (1) Shutting off all aerators from midnight to 8:00 am each day when aeration basin temperature was approximately 21 C; (2) Shutting off all aerators from 4:00 am to 8:00 am each day when wastewater temperature was less than 20 C; (3) Alternating aerobic and anoxic periods throughout every 24-hr day, during which anoxic conditions existed 12% of the time. This was effective at wastewater temperatures up to 24 C; and (4) Maintaining a DO concentration less than or equal to 0.8 mg/L from noon to 9:00 am each day was also moderately effective in controlling scum. (Lantz-PTT)
W88-04076

HEALTH SERVICES AND WATER AND SANITATION SERVICES IN THE NORTHWEST TERRITORIES: AN EXAMINATION OF THE PRESENT STATE OF DEVELOPMENT AND SOME THOUGHTS FOR THE FUTURE,

Izaak Walton Killam Hospital for Children, Halifax (Nova Scotia).
For primary bibliographic entry see Field 5F.
W88-04077

BOSTON PROJECT TESTS METHODS AND MARKETS,

Massachusetts Water Resources Authority, Boston.
For primary bibliographic entry see Field 5E.
W88-04087

TREATING WASTEWATER WITH HYACINTHS,

Austin Water and Wastewater Utility, TX.
J. Doersam.
Biocycle BCYCDK, Vol. 28, No. 7, p 30-32, August, 1987.

Descriptors: *Water hyacinth, *Biological wastewater treatment, *Sludge disposal, *Composting, *Wastewater facilities, Suspended solids, Biochemical oxygen demand, Aeration, Filtration, Nutrient removal, Nitrogen removal, Phosphorus removal, Waste management, Recycling.

In 1985, the city of Austin, Texas began operating the Hornsby Bend Hyacinth Facility (HBHF), a natural wastewater treatment system consisting of three parallel hyacinth ponds enclosed by a greenhouse to provide protection for year-round operation. Influent to the HBHF is from the last of three oxidation ponds receiving waste-activated sludge and anaerobic digester supernatant. Influent to each hyacinth pond is introduced through submerged 16-inch perforated pipes located at the head, 210 feet and 420 feet from the head, respectively. Ten percent of the surface area in each pond is left free of hyacinth to provide aeration for fish and other beneficial organisms that control mosquitoes and algae. Each pond outfall area is surrounded by a three-foot crushed rock barrier to prevent any hyacinth plants from being discharged into the Colorado River. An 11-foot cascade provides aeration to maintain a 6 mg/l minimum dissolved oxygen residual at the discharge. The HBHF has been most effective in the removal of total suspended solids and nutrients (nitrogen and phosphorus), and to a lesser degree, biochemical oxygen demand. To maximize nutrient removal, an intensive, well-managed harvesting program is carried out. When overcrowding is evident, plants at the edge of the ponds are removed by tines mounted on a backhoe. Removed material is solar dried then combined with sludge for compositng. The final compost product is stored and transferred as needed to other city departments to be used as soil amendments. The HBHF was constructed at a total cost of around $1.3 million. The main expense in operating the facility has been in plant harvesting. Three experiments that are currently under way at the facility include: mathematical modeling of the oxygen transfer process in hyacinth ponds; an innovative method of enhancing the nitrification process by recycling effluent into the plant leaves; and a rock/bamboo filter which may be used for further polishing of hyacinth pond effluent. (Geiger-PTT)
W88-04088

MONITORING TRANSPORT OF SELECTED PESTICIDES AND PHENOLS IN SOIL COL-

UMNS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Robert S. Kerr Environmental Research Lab., Ada, OK.
D. C. Bouchard.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 4, p 391-402, 1987. 1 fig, 2 tab, 15 ref.

Descriptors: *Wastewater treatment, *Path of pollutants, *Fate of pollutants, *Pesticides, *Phenols, *Soil columns, Municipal wastewater, Chromatography, Solute transport, Detection limits, Organic compounds, Monitoring, Infiltration, Sand, Wastewater, Chemical analysis.

Sandy soils in columns were used to study the transport of pesticides and phenols to approximate the conditions associated with the high permeabilities characteristic of rapid infiltration systems used in municipal wastewater treatment. A high pressure liquid chromatography procedure is developed for the quantitative determination of atrazine, diuron, carbofuran, phenol, 2,4-dinitrophenol, 2,4-dimethylphenol, and 2,4-dichlorophenol in the soil and wastewater. The method has the advantages of short sample analysis times and good analytical precision. In addition, modifications of the relative proportions of the ternary mobile phase used will allow for the future resolution of other similar phenols and pesticides. Recoveries of all analytes used were greater than 90%. The method detection limits for all the analytes are less than or equal to 0.03 micrograms/milliliter (ug/ml) (s/n = 4) in wastewater and less than or equal to 0.1 ug/ml (s/n = 5) in soil. Only 2,4-dinitrophenol and 2,4-dichlorophenol were reduced to nondetectable levels in the soil column effluent indicating that the pesticides and phenols present in municipal wastewater may not be adequately treated in rapid infiltration systems. (Wood-PTT)
W88-04117

POTENTIAL OF ACID ACTIVATED CLAYS IN THE CLARIFICATION OF MENHADEN STICKWATER,
Hostos Community Coll., Bronx, NY. Dept. of Natural Sciences.
P. F. Castillo, R. M. Rao, and J. A. Liuzzo.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 4, p 471-489, 1987. 9 tab, 12 ref.

Descriptors: *Activated clays, *Wastewater treatment, *Clarification, *Food-processing wastes, *Menhaden, Fish, Industrial wastewater, Effluents, Fats, Proteins, Solids, Hydrogen ion concentration, Coagulation, Stickwater, Clay.

The processing of menhaden by wet reduction for a profitable recovery of fish oil produces waste in the form of stickwater, which is the effluent obtained after the oil is separated by centrifugation from the liquor produced from the cooking and pressing of the fish. The feasibility of using acid activated clays to clarify menhaden stickwater effluent is determined. Experiments were performed to determine physical and chemical properties and the effects of changes in pH, temperature, coagulation, and coagulation followed by clay treatment in the separation of solids in stickwater. Analysis of the stickwater showed that it contains 4.5% crude protein, 1.4% crude fat, 6.5% total solids, 1.13% ash, and 93.1% water. Precipitation of fat increases with increasing temperature, while the reverse is found for protein. A pH of 4.0 gives the maximum clarification at all temperatures used. The viscosity decreases at pH values above and below the original pH of the sample. Among the four different acid activated clays used (trade names Supact-150, Impact-150, Impact-12 and Impact-100RR), Impact-150 is the most effective in protein and fat precipitation, and the degree of separation of these components increases with the treatment of the stickwater with a coagulant (aluminum sulfate) prior to treatment with acid activated clay. (Wood-PTT)
W88-04119

ACTIVATED SLUDGE TREATMENT OF WASTE WATER CONTAMINATED WITH HEAVY METALS: ADVANTAGES OF THE USE OF SEPIOLITA INTO THE BIOLOGICAL UNITS,
Madrid Univ. (Spain). Dept. of Chemical Engineering.
J. Tijero, M. J. Martin, and F. J. Mirada.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 5, p 411-425, July 1987. 9 fig, 1 tab, 25 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Heavy metals, *Sepiolita, Activated sludge, Copper, Chromium, Chemical oxygen demand, Effluents.

The results obtained in an activated sludge pilot plant when 10 milligrams/liter Cu(2+) or 10 milligrams/liter Cr(3+) were added to the wastewater feed at the same time as varying amounts of sepiolita were introduced into the aeration tank of the biological unit are presented. The system behavior was monitored through the evolution COD removal efficiency and the metal concentration, both in the effluent and in the activated sludge. The operation conditions used were fixed for the highest COD removal efficiency of the system without both metal and sepiolita; it was, therefore, operated with a mean-cell residence time between 7 and 13 days. The results show that the sepiolita addition, even in small quantities, allowed the system efficiency to be maintained or, in some cases, improved with respect to the organic matter and metal removal. (Author's abstract)
W88-04125

EFFECT OF SURFACTANT CONCENTRATION ON THE FLOTATION OF HYDROCARBONS FROM THEIR EMULSIONS. II. REMOVAL OF HEXADECANE,
Gdansk Technical Univ. (Poland). Inst. of Inorganic Chemistry and Technology.
K. B. Medrzycka, and W. Zwierzykowski.
Separation Science and Technology SSTEDS, Vol. 22, No. 6, p 1637-1643, 1987. 5 fig, 8 ref.

Descriptors: *Cleanup operations, *Surfactants, *Hydrocarbons, *Hexadecane, *Wastewater treatment, *Flotation, Oil pollution, Chemical treatment, Sodium chloride.

Flotation of hydrocarbons from their aqueous emulsions depends to a considerable extent on the efficiency of the collision of air bubbles with the emulsified globules. The collision efficiency greatly depends on the surface energy of the two boundaries: air-water, hydrocarbon-water, and hydrocarbon-air. Two of the parameters which influence those energies are type and concentration of the surface-active compound present in the flotation system. It was stated in a previous paper that the lower the surfactant concentration, the more effective is the flotation of mesitylene from its emulsion. This study hypothesizes that in the case of the flotation of hexadecane the dependence will be similar, and that flotation without any surfactant will be the most effective. On the basis of the flotation results, the removal of hexadecane from its aqueous emulsions is much poorer than the removal of mesitylene described earlier. The improvement of flotation efficiency by lowering the surfactant concentration is insignificant, but the lower this concentration, the higher the flotation efficiency of hexadecane. The best effect was observed in the absence of surfactants. The flotation efficiency of hexadecane is improved when agents increasing the coalescence are used. Therefore, the proper sodium chloride concentration is needed to reduce the thickness of the diffuse electric layer, which positively influences the coalescence of oil droplets and their attachment to gas bubbles. This NaCl concentration was about 0.5 mol/cu dm, and the use of such a concentration in the flotation mixture results in good flotation efficiency, especially in batch process for which 100% removal was found. (Lantz-PTT)
W88-04173

VOC REMOVAL FROM GROUNDWATER - A CASE HISTORY,
Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, PA.
For primary bibliographic entry see Field 5G.
W88-04175

L.A.'S WASTEWATER TREATMENT PLANT: VICTIM OR VILLAIN,
A. B. Nichols.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 932-938, November 1987.

Descriptors: *Wastewater treatment facilities, *Regulations, *Fines, *Los Angeles, *Municipal wastewater, *Sludge disposal, *California, Costs, Storm runoff, Urban runoff, Waste disposal, Management planning, Economic aspects, Clean Water Act.

On February 19, 1987, an amended consent decree was filed in the U.S. District Court for the Central District of California that requires the city of Los Angeles (L.A.) to pay a fine of $625,000 for Clean Water Act violations. The decree requires the city to spend not less than $3.3 million to investigate and remediate local urban runoff, which includes storm water discharges, into Santa Monica Bay. Additional requirements under the amended decree are that L.A. must terminate its ocean discharge of wastewater sludge from its Hyperion Wastewater Treatment Plant no later than December 31, 1987 and convert the plant to full secondary treatment by June 30, 1988. L.A. must also comply with stringent interim effluent limits pending construction of full secondary treatment facilities. The cash fine of nearly three-quarters of a million dollars, paid directly to the U.S. Treasury, and the storm water project requirement, constitute the largest civil penalty package ever assessed under the Clean Water Act against a municipality. More astounding, this was not the first time L.A. was cited for water pollution control violations caused by discharges from Hyperion. On June 19, 1980 a partial consent decree was filed in the same proceeding, which required the city to transfer $2,165,000 of city funds into an Environmental Trust Fund for 'environmentally beneficial projects which have been proposed by the City and approved by the EPA.' The 1980 decree gave the city until July 1, 1985 to discontinue its practice of discharging sludge into the ocean. In pursuit of compliance, the city planned to construct a system, known as the Hyperion Energy Recovery System or (HERS) to dry and incinerate the sludge. However, L.A. could not meet the deadline and EPA granted several extensions. When the city was unable to meet the last extended deadline, EPA put its foot down. An equitable solution to all concerned may have been the result, but the city paid a heavy price. It called EPA's bluff and lost. And it was perhaps understandable why it thought it could win. Many cities delay expensive compliance decisions for political reasons, and the same is often true for the federal government. No enforcement agency, including EPA, wants to make the tough decision to instigate litigation against a politically powerful metropolitan area. That's the reason why few major cities seem to be targets of EPA litigation under the Clean Water Act. (Lantz-PTT)
W88-04194

IMPROVED DESIGN AND OPERATIONAL PRACTICES FOR MUNICIPAL SLUDGE INCINERATORS,
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
For primary bibliographic entry see Field 5E.
W88-04195

SPATIAL HYDRAULIC RESPONSE OF A SUBSURFACE EFFLUENT LINE SOURCE,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
G. V. Wilson, H. D. Scott, and D. B. Marx.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 944-949, November 1987. 6 fig, 1 tab, 28 ref.

Descriptors: *Wastewater treatment, *Soil disposal fields, *Septic tanks, *Effluents, *Soil water, Seepage, Anisotropy, Permeability coefficient, Kriging,

Soil water potential, Statistical studies, Mathematical analysis.

The hydraulic response of conventional, single-line source septic filter field, installed in a Captina silt loam (Typic Fragiudult), was investigated for 2 years. Temporal and spatial distributions of soil water potential were monitored. Spatial dependence of these data were analyzed and soil water matric potentials were kriged. The semi-variograms were anisotropic with nugget of zero and range of approximately 1.2 m for all days tested. The variance between two independent points (sill) increased as the soil water matric potential near the soil surface decreased. The sill was found to be an exponential function of the variation of matric potentials. Equipotential lines in the filter field were constructed and the perched groundwater mound depth (zero equipotential line) varied during the year. This mound occurred in the Bx and Bt horizons. Between July and October, the groundwater mound was within 2.5 m of the seepage bed. Nonuniform effluent redistribution occurred in the soil profile where the groundwater mound was shallower: below the seepage bed middle and not below the inlet end. The cause was the irregular fragipan horizon boundary. (Author's abstract)
W88-04196

RAPID REMOVAL OF COLLOIDAL SUBSTRATE FROM DOMESTIC WASTEWATERS,
Louisiana Tech Univ., Ruston. Dept. of Civil Engineering.
B. Bunch, and D. M. Griffin.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 957-963, November 1987. 7 fig, 3 tab, 17 ref.

Descriptors: *Domestic wastes, *Wastewater treatment, *Colloids, Activated sludge, Flocculation, Chemical oxygen demand, Biological oxygen demand, Biological treatment.

A major assumption in the design of the contact stabilization activated sludge process was studied: rapid removal of colloidal substrate by physical adsorption onto biological floc, followed by enzymatic breakdown and biological utilization. Results show that an operationally defined colloidal fraction (between 0.03 and 1.5 micrometers), measured as chemical oxygen demand, is totally removed within 5 minutes at low food to microorganism ratios (0.05 to 0.3). The speed and degree of removal strongly suggests some type of physical process. However, no evidence of subsequent solubilization and utilization as substrate was observed. (Author's abstract)
W88-04198

ANAEROBIC DEGRADATION OF CHLORINATED SOLVENTS,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
C. Vargas, and R. C. Ahlert.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 964-968, November 1987. 12 fig, 1 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Chlorinated solvents, Microbial degradation, Dichloromethane, Dichloroethane, Trichloroethane, Organic compounds, Biological treatment, Degradation.

The in situ degradation of chlorinated solvents and the role of anaerobic microbial communities was studied. Half-kill doses were estimated. Dichloromethane, dichloroethane, and trichloroethane yielded results of 0.5, 26, and 4 mg/L, respectively. Acclimation studies were carried out with the two-carbon compounds and ethanol. Dichloroethane appeared to be less toxic. All activity ceased but resumed after an extended lag. In separate acetogenic and methanogenic culture experiments with trichloroethane total inhibition of the acetogenic organism activity was observed. Trichloroethane had no effect on the methanogenic community. Primary substrate utilization dropped to nil for all halocarbon concentrations tested on acetogenic cultures. Substrate utilization by the methanogenic cultures remained constant; 60 to 100% degradation was observed in 35 days. (Author's abstract)
W88-04199

PRECURSORS OF NON-VOLATILE CHLORINATION BY-PRODUCTS,
Clean Harbors, Inc., Braintree, MA.
S. Fam, and M. K. Stenstrom.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 969-978, November 1987. 7 fig, 5 tab, 31 ref. Calif. Dept. of Water Resources Contract No. B-54863.

Descriptors: *Wastewater treatment, *Chlorination, *Disinfection, *Byproducts, Halogens, Chemical analysis, Pollutant identification, Chemical properties.

Chlorination of tertiary-treated domestic wastewaters produces an abundance of non-volatile, gas chromatographable halogenated organics, in addition to the well known trihalomethanes. In an effort to reduce the occurrence of the unwanted nonvolatile chlorinated byproducts, precursors were studied using several fractionation and pretreatment techniques. The techniques were developed to differentiate potential precursor compounds on the basis of their molecular weight, polarity, and solubility. The major precursors had molecular weights less than 1000, were slightly soluble in organic solvents, were acidic, polar, and common to many wastewaters. The precursors are likely to be modified plant pigments due to secondary treatment and other biological and chemical alterations that the molecules may undergo. The smaller polar compounds that are the least likely to be removed by treatment are the most reactive with chlorine for the examined subset of total organic halogens. (Lantz-PTT)
W88-04200

CONTROL OF ANAEROBIC DIGESTER FOAMING,
East Bay Municipal Utility District, Oakland, CA.
M. J. Tetreault, and D. M. Diemer.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 987-988, November 1987.

Descriptors: *Anaerobic digestion, *Foaming, *Wastewater treatment, Biological treatment, Activated sludge, Sludge solids, Digestion, Nocardia.

The East Bay Municipal Utility District's (District), Oakland, CA, full-scale experience since an original laboratory investigation supports the finding that waste activated sludge containing Nocardia is a key factor related to digester foaming. However, it seems that Nocardia is not the sole foaming cause in the anaerobic digesters at the District's wastewater treatment plant. Recent experience indicates that both Nocardia and digester solids concentrations contribute to foaming problems. Key operating parameters identified at the District's wastewater treatment plant to control foaming in anaerobic digesters are: a mean cell residence time (MCRT) less than 2 days; feed sludge solids less than 4%; and digester solids concentration of less than 2%. (Lantz-PTT)
W88-04202

HYDRAULIC PERFORMANCE OF PERCOLATING BIOLOGICAL FILTERS AND CONSIDERATION OF OXYGEN TRANSFER,
J. Suschka.
Water Research WATRAG, Vol. 21, No. 8, p 865-873, August 1987. 10 fig, 1 tab, 18 ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Biofilters, *Oxygen, Hydraulic load, Diffusion, Hydraulic properties, Percolation, Biofilms.

A distinct difference exists between the experimentally measured and theoretically calculated values of residence time in percolating biological filters. From existing information it was shown that the measured values are usually at least three times higher than those calculated theoretically. Based on several premises, it was concluded that two liquid layers should be distinguished. One 'free' liquid film flowing on top of the biofilm, the second 'captured' flowing through the biofilm. From experimentally measured residence time, it was evident that the total liquid film depth would be in the region of 150-550 micrometers for a hydraulic load range of 0.02-5 cu m/sq m/m. Oxygen cannot penetrate up to such a depth, especially when the captured liquid film thickness is in the region of 110-380 micrometers. The largely anoxic conditions in the captured liquid film are in contrast with the prevailing conditions close to oxygen saturation in the free flowing liquid layer. Due to the large developed surface the outflowing liquid can be saturated with oxygen. The measured oxygen concentration in filter effluent does not reflect the aerobic conditions in the captured liquid film nor in the biofilm as such. (Author's abstract)
W88-04246

ADSORPTION OF MERCURY (II) BY COAL FLY ASH,
Visva-Bharati Univ., Santiniketan (India). Dept. of Chemistry.
A. K. Sen, and A. K. De.
Water Research WATRAG, Vol. 21, No. 8, p 885-888, August 1987. 5 fig, 1 tab, 7 ref.

Descriptors: *Adsorption, *Fly ash, *Wastewater treatment, *Mercury, Heavy metals, Solid wastes, Hydrogen ion concentration, Chemical treatment.

Water pollution due to heavy metals such as mercury, is a serious global problem. Activated carbon filtration, preceded by treatment with lime or ferric chloride or alum is a known method for the removal of heavy metals, but the high cost of activated carbon limits its large scale use for the abatement of heavy metal pollution in developing countries. Coal fly ash, an industrial solid waste of thermal power plants, is one of the cheapest and most unconventional adsorbents. Zinc and organic acids have been removed from aqueous solutions using coal fly ash. Coal fly ash has a good adsorption capacity for mercury (II). Adsorption of mercury (II) on coal fly ash conforms to Freundlich's adsorption model. Several parameters such as time of equilibrium, effect of pH, effect of initial concentration of solute, effect of fly ash dose etc. were studied. The maximum adsorption was observed after shaking for 3 hr. Solution pH was the most important parameter affecting the adsorption. The optimum pH range was 3.5-4.5. There was total adsorption of mercury below 10 mg/L. The performance of coal fly ash as an adsorbent was significant when compared with activated powdered charcoal. (Lantz-PTT)
W88-04248

CONCEPTUAL BASIS FOR MICROBIAL SELECTION IN BIOLOGICAL WASTEWATER TREATMENT,
Pretoria Univ. (South Africa). Dept. of Water Utilisation Engineering.
W. A. Pretorius.
Water Research WATRAG, Vol. 21, No. 8, p 891-894, August 1987. 3 fig, 15 ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Microorganisms, Microbiological studies, Selectivity.

In biological wastewater treatment plants special groups of microorganisms responsible for the purification process are selected by plant design and operating conditions. Use is made of the physiological and physical properties of the microorganisms to create primary and secondary selection pressure conditions respectively. Secondary selection is achieved with special techniques ('microbial selectors') based on e.g. cell settlement properties and size, and occurs only in continuous and semi-continuous systems. Each combination of primary and secondary selection conditions creates an unique population of microorganisms. Examples are given in which the microbial selection concept is utilized to select for wanted or remove unwanted microorganisms, such as the solid surfaces provided in trickling filters, the secondary clarifier in activated

sludge plants, and the Upflow Anaerobic Sludge Bed process. (Author's abstract)
W88-04250

OXIDATION OF PHENOLIC COMPOUNDS BY OZONE AND OZONE + U.V. RADIATION: A COMPARATIVE STUDY,
Drexel Univ., Philadelphia, PA. Civil Enginering and Environmental Sciences Inst.
M. D. Gurol, and R. Vatistas.
Water Research WATRAG, Vol. 21, No. 8, p 895-900, August 1987. 14 fig, 17 ref. NSF Grant No. CEE-8204922.

Descriptors: *Oxidation, *Phenols, *Ozonation, *Wastewater treatment, *Ultraviolet radiation, Comparison studies, Hydrogen ion concentration, Chemical treatment, Organic carbon.

The reaction mechanisms of oxidation of various phenolic compounds by ozone and ozone + u.v. radiation at pH 2.5, 7.0 and 9.0, was investigated. Experimental results indicate that the molecular ozone is the predominant oxidant only at acidic pH; at neutral and basic pH, in the absence or presence of u.v. radiation, free radical reaction is the major pathway in the oxidation of phenolic compounds. The overall removal of phenols and the removal of TOC increase with increasing pH during ozonation with or without u.v. light. For a specific pH, the removal rates of phenol and TOC are highest for ozone + u.v. light followed by ozone and then u.v. light alone. (Author's abstract)
W88-04251

WET AIR REGENERATION OF PAC: COMPARISON OF CARBONS WITH DIFFERENT SURFACE OXYGEN CHARACTERISTICS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
C. A. Wedeking, V. L. Snoeyink, R. A. Larson, and J. Ding.
Water Research WATRAG, Vol. 21, No. 8, p 929-937, August 1987. 8 fig, 2 tab, 17 ref. EPA Contract Nos. CR 806819 , CR 810462, and CR 812582.

Descriptors: *Wastewater treatment, *Activated carbon, *Oxygen, Phenanthrene, Carbon regeneration, Nitrophenol, Organic carbons, Adsorption.

Surface oxygen has an important effect on the wet air regeneration (WAR) of powdered activated carbons (PAC) and on the adsorption properties of the regenerated PAC. Virgin and phenanthrene-loaded PACs were regenerated in a bench-scale reactor, and then analyzed to determine surface oxygen content, adsorption capacity, and extent of phenanthrene oxidation. Even though the virgin wood-base (WB) and lignite-base (LB) PACs had about the same oxygen content, the oxygen content of the WB PAC increased more than twice as much as the LB PAC during regeneration. The difference was caused by the larger amount of CO2-evolving oxides that formed on the WB PAC. WAR reduces the capacity of PAC for p-nitrophenol (PNP). Removing the surface oxides had varying effects on the carbon's capacity for PNP. Adsorbed phenanthrene was more easily oxidized on the WB PAC than on the LB PAC during regeneration. (Author's abstract)
W88-04255

OPERATING CHARACTERISTICS OF THE AERATED SUBMERGED FIXED-FILM (ASFF) BIOREACTOR,
Kuwait Univ., Safat. Dept. of Civil Engineering.
M. F. Hamoda, and M. F. Abd-el-Bary.
Water Research WATRAG, Vol. 21, No. 8, p 939-947, August 1987. 10 fig, 2 tab, 18 ref.

Descriptors: *Wastewater treatment, *Fixed-film reactors, *Biological treatment, Chemical oxygen demand, Hydraulic loading, Biomass, Aeration.

A multi-stage fixed-film reactor was developed in which a stationary submerged biofilm is attached to ceramic tiles under diffused aeration. Tracer studies revealed that the reactor's hydraulic regime is described by a CSTR-in-series (completely stirred tank reactor) model. Reactor performance at 20 C was examined using sucrose wastewaters with organic strength up to 900 mg/L COD, at hydraulic loadings up to 0.1 cu m/sq m/day and organic loadings up to 90 g COD/sq m/day. The reactor demonstrated the capability of achieving 97% soluble COD removals at low loadings and exhibited efficient and stable performance at high hydraulic and organic loadings. Even at application rates near the rate-limiting mass loadings, there was only a 9% loss in efficiency. Reactor operation at high loadings appears to be advantageous since organic substrate removal rates and attached biomass per unit surface area increased with the increase in organic loading. This can be attributed to the good oxygen transfer and the considerable quantity and type of attached biomass attained. Staging of the reactor proved to be effective in eliminating short circuiting and damping excessive loadings, although the majority of COD removal occurs in the first stage which retains the greatest quantity of attached biomass. A good quality effluent was produced. (Author's abstract)
W88-04256

REPEATED EXHAUSTION AND CHEMICAL REGENERATION OF ACTIVATED CARBON,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. J. Martin, and W. J. Ng.
Water Research WATRAG, Vol. 21, No. 8, p 961-965, August 1987. 3 fig, 1 tab, 4 ref.

Descriptors: *Activated carbon, *Regeneration, *Wastewater treatment, *Chemical regeneration, Exhaustion, Nitrobenzene, Adsorption, Rhodamine.

Experimental data on the repeated application of the cycle of exhaustion, chemical regeneration and re-exhaustion of activated carbon are presented. The adsorbates studied were nitrobenzene (a small organic molecule of mol. wt approximately 123), Rhodamine B (a much larger adsorbate of mol. wt approximately 480) and humic acid (an ill-defined substance consisting of macromolecules of molecular weight predominantly in the range 20,000-50,000). The regenerants used were all organic with solubilizing powers to encourage the physical displacement of the adsorbate molecule by the regenerant molecule. It is concluded that chemical regenerants could be used to regenerate granular activated carbon repeatedly with little loss of adsorption capacity. Earlier studies which considered the effect of water on the pores of the carboxylic acid regenerants were confirmed. Bonding between the acids and water hindered the regeneration process. (Author's abstract)
W88-04259

PROCESS CONSIDERATIONS IN BIOLOGICAL TREATMENT OF LOW CONCENTRATION WASTEWATERS. II. DYNAMICS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
W. J. Maier, G. M. Klecka, and R. E. Bailey.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 108-112, August 1987. 7 fig, 2 tab, 11 ref.

Descriptors: *Activated sludge process, *Varied flow, *Water quality control, *Wastewater treatment, *Biological wastewater treatment, *Mathematical models, Optimization, Stage treatment, Industrial wastewater, Flow rates, Kinetics, Shock loads, Chlorinated hydrocarbons, Wastewater treatment, Model studies, Sludge digestion.

The performance of activated sludge type treatment systems operating at non-steady state conditions has been analyzed using mathematical models. The results show that the inventory of active biomass is a rate limiting factor when the system is stressed by imposing higher flows or feed concentration. Using a series of well mixed reactors results in more complete removal of substrate than does a single stage with the same volume. Staging becomes more critical at low substrate concentrations and is more beneficial than extending residence time. The magnitude and duration of changes in substrate removal efficiency have been characterized for a series of imposed changes in flow rate and feed concentration. Model predictions show that higher feed concentrations result in lower effluent concentrations (except in single reactor systems). This finding has important practical implications for optimizing treatment of low concentration wastewaters where essentially complete removal of a specific chemical is desired. It indicates that changes in manufacturing that are aimed at reducing the concentration of a specific chemical in the waste stream do not necessarily result in lower discharges of that chemical from the wastewater treatment system. However, if dilution of the waste stream can be minimized, overall removal will be enhanced and the discharge concentration will be reduced. (Airone-PTT)
W88-04339

LOW COST CONTROLLED COMPOSTING OF REFUSE AND SEWAGE SLUDGE,
Leeds Univ. (England). Dept. of Civil Engineering.
J. T. Pereira-Neto, E. I. Stentiford, and D. D. Mara.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 839-845, 1987. 5 fig, 1 tab, 7 ref.

Descriptors: *Costs, *Composting, *Wastewater disposal, *Sludge disposal, Aeration, Biodegradation, Temperature, Bacteria, Sanitation, Economic aspects.

The forced aeration static pile composting system was used to compost mixtures of domestic refuse and sewage sludge. Several different control methods have been evaluated over the past four years from simple, low cost fixed rate aeration timers to microcomputer based systems. Their relative merits are considered. In a compost pile using temperature feedback control the number of Escherichia coli were reduced from 1.0 times 10 to the 7th power organisms/gm to less than 200 organisms/gm within 16 days. Fecal streptococci were reduced from 1.0 times 10 to the 7th power to less than 200 organisms/gm, within 30 days. The process consistently produced a good quality sanitized material under a range of control regimes. (Author's abstract)
W88-04368

REGIONAL SLUDGE TREATMENT AND DISPOSAL OPTIMIZING RELIABILITY AND COST,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. H. Hahn.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 847-857, 1987. 4 fig, 4 tab, 9 ref.

Descriptors: *Sludge disposal, *Wastewater treatment, *Costs, Optimization, Waste disposal, Wastewater management, Management planning, Economic aspects.

With the increasing number of wastewater treatment facilities and increasing intensity of treatment the amount of sewage sludge will grow and sludge disposal will assume a significant place in environmental quality control. Sewage sludge is considered both a valuable resource for agriculture, and a waste material which must be disposed of safely. Thus, regional solutions must be aimed for if available sites for agricultural application or a limited number of disposal sites are to be used wisely. Technically and economically feasible alternatives of treatment (and disposal) are numerous. The selection process involves a minimization of overall cost and/or an optimization of process reliability and cost. There exist proven mathematical tools for the solution of such optimization problems, including dynamic programming routines have been utilized. The applicability of these methods, as well as their limits, are shown in a practical case study of sludge disposal in the Upper Rhine Region. (Lantz-PTT)
W88-04369

CONDITIONING OF BIOLOGICAL SLUDGES WITH CATIONIC POLYELECTROLYTES,

Ytkemiska Inst., Stockholm (Sweden).
L. Eriksson.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 859-868, 1987. 6 fig, 3 tab, 20 ref.

Descriptors: *Sludge conditioning, *Wastewater treatment, *Cationic polyelectrolytes, Activated sludge, Electrophoresis, Turbidity, Polymers, Flocculation, Sludge volume.

Factors determining polyelectrolyte choice and dosage in conditioning of activated sludge were investigated. Due to differences in particle size distribution electrophoretic mobility did not correlate with optimal dosages. Instead the polyelectrolyte consumption could be explained by a linear model containing the variables: sludge volume index, rest turbidity, floc break up factor obtained by CST-stirring test and CST (Capillary Suction Time) of unconditioned sludge. For the investigated sludges biopolymers and colloidal particles were the main consumers of polyelectrolyte which, however, also was needed to build the existing flocs to optimum properties. The model was statistically less significant in the cases of high stirring times and high sludge volume indexes. Sludges with high amounts of dispersed particles were best conditioned by a high molecular weight and moderately charged polymer while for well flocculated sludges with high sludge volume index a high charge density polymer was most suitable. (Author's abstract)
W88-04370

STUDY OF A NON-CONVENTIONAL AERATION SYSTEM,
L. Raschid-Sally, M. Roustan, H. Roques, and G. M. Faup.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 869-876, 1987. 3 fig, 5 tab, 6 ref.

Descriptors: *Aeration, *Wastewater treatment, Jets, Circulation, Flow patterns, Flow velocity, Mathematical studies.

A non-conventional aeration system for oxidation ditches using jets is based on the principle of the separation of the 2 actions: aeration and circulation. The oxygen transfer can be controlled very effectively by controlling the air flow rate injected into the jet, with the advantage that the aeration can be totally or partially stopped (for example, during slack hours) while maintaining a good circulation. Systems of this type are particularly suited to low load (or long residence time) processes such as oxidation ditches where the necessary oxygen transfer coefficient is 0.06/mn in fresh water. The circulation flow in the channel poses no problems. The velocities necessary for maintaining solids in suspension are very easily attained. The flow of the liquid in the channel can be successfully modelled using various theoretical approaches. The mean circulation velocity, the power dissipated, and the Peclet number, are the 3 important parameters governing the circulation. The oxygen transfer capacity of the system has been studied and compares favorably with that of conventional systems. (Lantz-PTT)
W88-04371

TEMPERATURE INFLUENCE ON ABSORPTION AND STRIPPING PROCESSES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
B. M. Khudenko, and A. Garcia-Pastrana.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 877-888, 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Temperature, *Wastewater treatment, *Absorption, *Stripping, Mass transfer, Simulation analysis, Energy, Gas transfer, Methane, Oxygen.

The influence of temperature on mass transfer rates in gas absorption and stripping processes has been evaluated. A computer simulation analysis has been used to identify fundamental reasons for variations among temperature correlation factors published in the literature. A critical molecular transfer energy was postulated and the temperature correction factor was developed based on the Maxwell distribution law. The critical energy hypothesis was experimentally validated and the critical energy of molecules crossing the gas-liquid interface of 2.6 times to the -13th erg was determined for both methane and oxygen in the temperature range from 5 C to 75 C. The critical energy was a constant value for various hydrodynamic conditions and also for water with and without surfactants. The temperature correction expression derived based on the critical energy hypothesis was compared with several published relationships. The comparison has corroborated that the developed temperature correction relationship is applicable to various kinds of gas transfer apparatus and hydrodynamic regimes. (Author's abstract)
W88-04372

DYNAMIC CHANGES IN POPULATIONS OF THE ACTIVATED SLUDGE COMMUNITY: EFFECTS OF DISSOLVED OXYGEN VARIATIONS,
California Univ., Berkeley. Dept. of Civil Engineering.
S. W. Hermanowicz.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 889-895, 1987. 4 fig, 1 tab, 13 ref.

Descriptors: *Activated sludge, *Dissolved oxygen, *Bacteria, Microbiological studies, Filamentous bacteria, Floc-forming bacteria, Population dynamics.

Mathematical model was developed to describe a microbial system composed of two populations: filamentous and floc-forming bacteria. Growth rates of both microorganisms depend on the concentration of a single organic substrate and on the dissolved oxygen (DO) concentration. Biokinetic parameters were estimated from the experimental data reported in the literature. Using these parameters population changes were examined under variable DO concentrations. The comparison of the numerical simulations and experimental data indicated a possibility of controlling population composition within a desired range through periodic changes in DO concentration. The existence of a single common trajectory on the phase plane guarantees the stability of the designed cycle. (Author's abstract)
W88-04373

INFLUENCE OF OXIC AND ANOXIC MIXING ZONES IN COMPARTMENT SYSTEMS ON SUBSTRATE REMOVAL AND SLUDGE CHARACTERISTICS IN ACTIVATED SLUDGE PLANTS,
Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.).
H. Hoffman.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 897-910, 1987. 8 fig, 6 tab, 13 ref.

Descriptors: *Mixing zones, *Activated sludge, *Wastewater treatment facilities, Chemical oxygen demand, Sludge dewatering, Mixing, Biological oxygen demand, Bulking sludge, Settleability.

The influence of activated sludge compartment systems with and without anoxic mixing zone on the efficiency of the system and the settleability and dewatering characteristics of the activated sludge was tested. COD-load, number and volume of the compartments and the mixing zones were varied. Experiments were carried out with two pilot plants, a compartment system and a totally mixed system. The tests clearly indicate that a four-stage cascade system with a BOD-load of about 1.0 kg/cu m/day could improve settleability and dewatering characteristics, but bulking sludge could not be avoided. Using a nonaerated upstream zone with a volume load of 4.0 kg/cu m/day the settling properties in the compartment system (total BOD-load 1.0 kg/cu m/day) could be improved to such an extent that the formation of bulking sludge was prevented. Better settleability leads to the higher solids concentration in the cascade system and to a lower sludge load. Therefore lower BOD-outflow-concentrations and higher efficiency of the activated sludge system were available. (Author's abstract)
W88-04374

EFFECT OF ALTERNATING AEROBIC AND ANAEROBIC CONDITIONS ON THE ECONOMICS OF THE ACTIVATED SLUDGE SYSTEM,
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
S. Y. Ip, J. S. Bridger, and N. F. Mills.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 911-918, 1987. 3 fig, 2 tab, 14 ref.

Descriptors: *Aerobic conditions, *Anaerobic conditions, *Activated sludge, *Wastewater treatment, Economic aspects, Denitrification, Energy.

Results of both laboratory and field trials, indicate that the alternating aerobic/anaerobic activated sludge (AAA-CMAS) system is capable of producing an effluent of high quality in either fully-loaded or under-loaded conditions. The aeration energy saving and the sludge reduction of the AAA-CMAS system about 30% and 15% respectively. Because denitrification processes are taking place within the reactor under controlled conditions and not in the sedimentation tank where degree of denitrification cannot be controlled, effluents of the AAA-CMAS system contain much less suspended solids and E. coli counts than those of a conventional system, resulting in further cost savings in chlorination and in back-washing of the filter. (Author's abstract)
W88-04375

POLYMERIZATION EFFECTS OF OZONE: APPLICATIONS TO THE REMOVAL OF PHENOLIC COMPOUNDS FROM INDUSTRIAL WASTEWATERS,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
J. P. Duguet, B. Dussert, J. Mallevialle, and F. Fiessinger.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 919-930, 1987. 9 fig, 8 tab, 11 ref.

Descriptors: *Polymerization, *Ozone, *Phenols, *Industrial wastewater, *Wastewater treatment, Organic compounds, Polymers, Oil wastes, Organic carbon, Ozonation.

Degradation of phenols by ozone has been extensively studied, but the oxidative coupling pathway of ozone resulting in a phenol polymerization has not been largely investigated. Application of low ozone dose in solutions of 2.4 dichlorophenol and salicylic acid is characterized by the formation of high molecular compounds which are partially insoluble. Numerous polymers have been identified by gas chromatography coupled with mass spectrometry. Application of the polymerization effect of ozone to petrochemical and coking wastewaters containing phenols give similar results. In each case, phenolic compounds are efficiently removed, even if a large organic content is present. In the case of petrochemical wastewater, where phenols represent only 30% of TOC, the ozone effects are not sufficient to merit an ozonation step on the present treatment line. On the other hand, when phenols represent the greater part of the organics, as in coking wastewater, an important fraction of insoluble compounds, easily removed by filtration, are formed. (Author's abstract)
W88-04376

PRELIMINARY INVESTIGATION INTO THE IMPROVEMENT OF THE BIODEGRADABILITY OF ORGANIC SUBSTANCES IN SURFACE WATERS AND EFFLUENTS THROUGH OZONATION,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
H. J. van Leeuwen.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 931-937, 1987. 5 fig, 13 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Organic compounds, *Biodegradation, *Ozonation, Biological oxygen demand, Chemical oxygen demand, Ozone, Surface waters.

The removal of non-biodegradable or refractory substances is expensive during both water and wastewater treatment. Tests were conducted with ozone to enhance the biodegradability of organic substances in three different surface waters and two effluents. At low concentrations of biodegradable substances, the effect of ozone could be measured by comparing the bacterial growth potential after ozonation with that in standard sodium acetate solutions, while at higher concentrations the BOD to COD ratio could be used. In all the cases biodegradability could be improved substantially by ozonating to an optimum dosage where the increase was maximized. Ozonation offers an economical treatment option for certain oil-from-coal plant effluents because of the ease of oxidation and additional removal potential or organic substances by foam fractionation and biodegradation. (Author's abstract)
W88-04377

DESORPTION OF CATIONIC POLYACRYLAMIDE FROM BLEACHED KRAFT PULP FIBERS,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
C. F. Warren, and R. Gehr.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 939-951, 1987. 9 fig, 25 ref.

Descriptors: *Desorption, *Pulp wastes, *Kraft mills, *Polyacrylamide, *Bleaching, Nitrogen, Hydrogen ion concentration, Pulp and paper industry, Wastewater treatment, Adsorption, Alum.

The adsorptive and desorptive behavior of a cationic polyelectrolyte contacted with wood pulp fibers was determined by total nitrogen analysis using a pyrolysis/chemiluminescence detection system. Dialyzed polymers generated an adsorption isotherm of higher affinity than did non-dialyzed polymers. Capacity adsorption was maximized at pH 7, but decreased in the presence of alum, depending on the dosage. Desorption of non-dialyzed polymer was caused by changes in pH above or below 7.0 as well as by addition of alum. However, for the alum doses typically encountered in paper manufacturing, significant desorption is unlikely. Nevertheless, the contaminants in non-dialyzed polymers do hinder adsorption, and effluents from those processes using both alum and polymer may contain quantities of unadsorbed or desorbed polyelectrolytes which could be damaging to receiving water bodies. (Author's abstract)
W88-04378

REJECTION OF ALKYL PHENOLS BY REVERSE OSMOSIS MEMBRANES,
Water Research Commission, Pretoria (South Africa).
C. F. Schutte, and G. Belfort.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 967-979, 1987. 8 fig, 3 tab, 10 ref.

Descriptors: *Alkyl phenols, *Phenols, *Reverse osmosis, *Wastewater treatment, Sodium chloride, Diffusion, Sorption, Cellulose acetate membranes.

The removal of different alkyl phenols by two commercially available reverse osmosis membranes, one cellulose acetate and one aromatic polyamide both with very high rejection of NaCl was investigated. The polyamide membrane rejected phenol very effectively while the cellulose acetate membrane showed virtually no phenol rejection. In order to explain these differences a study was made of the mechanisms of phenol rejection by the two membranes. Transient diffusion tests as well as partitioning tests were conducted in addition to the reverse osmosis experiments. It is concluded that phenol is sorbed in both membranes and that the forces of attraction between phenol and cellulose acetate are relatively weak compared to the attraction between phenol and polyamide resulting in a faster rate of diffusion in cellulose acetate and hence poor rejection. (Author's abstract)
W88-04380

DEVELOPMENT AND OPTIMIZATION OF A PROCESS COMBINATION OF A HIGHEST-LOADED ACTIVATED SLUDGE STAGE AND BIOLOGICALLY INTENSIFIED FILTRATION,
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft.
W. Firk, and N. Ghandehari.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 981-992, 1987. 9 fig, 1 tab, 9 ref, 3 append.

Descriptors: *Activated sludge process, *Biofiltration, *Wastewater treatment, Optimization, Filtration, Chemical oxygen demand, Biological wastewater treatment, Biological oxygen demand, Suspended solids.

Conventional sand- and two-layer filtration is frequently used for advanced wastewater treatment after low-loaded activated sludge systems. However, the effectiveness of this conventional filter in degrading difficult substances is extremely low and the costs are high. In direct comparison, modifying the filters to a biologically intensified system, brings about a substantial increase in efficiency while costing very little more. An investigation of a system consisting of an activated sludge process and a biologically intensified filter showed that, for the requirements of advanced treatment, the size of the activated sludge stage can be substantially reduced without the effectiveness of the system as a whole being affected. In the range of normal requirements (national effluent standards) and comparable low influx concentrations, biologically intensified filtration can be combined with a high-loaded activated sludge process of SLR up to 5 kg BOD/(kg MLSS.d). The area required for the construction of the system is less than 50% compared to the conventional one-stage activated sludge system. At higher influx concentrations the simultaneous addition of precipitants/flocculants to the high-loaded activated sludge stage, leads to substantial improvement of the effluent of the whole system and simultaneously to a distinct phosphorus elimination. This process modification is greatly advantageous, especially for densely populated lake areas. The oxygen supply system of the filter has a key function in connection with the influent concentration and the loading of the biological stage. (Author's abstract)
W88-04381

ADVANTAGES OF DUAL-MEDIA DRY FILTERS IN BIOLOGICAL WASTEWATER TREATMENT,
Societe Degremont, Rueil-Malmaison (France). Dept. Recherche Physico-Chimie.
Y. Richard, and C. F. Seyfried.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 993-1002, 1987. 6 fig, 4 tab, 6 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Filtration, Aeration, Suspended solids, Pilot plants, Flow rates, Dissolved solids.

Pilot plant studies of the treatment of various wastewaters were conducted using (1) water from secondary settling tanks of an existing treatment plant and (2) a mixture of water from the primary and secondary clarifiers and a solution of lactoserum. The ratio between soluble and insoluble pollution was varied. The study lasted for one and a half years with 10 months of actual testing. Sand and expanded slate gave the best results; water and air flow rates of 5 m/hr were chosen to attain the best performance possible with dry filtration on an industrial scale. Under these conditions with the waters tested, removal efficiences were 80% for suspended solids, 50% for the soluble COD and 63% for total COD. There was a deterioration of the quality of the treated water when the head loss rose above 1.5 m W.G. Based on these results and those of previous tests, an expansion of the Mannheim, W. Germany was designed. The filtration surface will be 87 sq. m per unit with 32 filters. The maximum dry weather flow will be 14,000 cu m/hr. (Lantz-PTT)
W88-04382

CONTROL OF BIOLOGICAL SCUM IN ACTIVATED SLUDGE PLANTS BY MEANS OF SELECTIVE FLOTATION,
Pretoria Univ. (South Africa). Dept. of Water Utilisation Engineering.
W. A. Pretorius, and C. J. P. Laubscher.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 1003-1011, 1987. 9 fig, 2 tab, 14 ref.

Descriptors: *Scum, *Activated sludge process, *Wastewater treatment, *Flotation, Biological wastewater treatment, Bacteria, Flocculation, Pilot plants.

The occasional occurrence of a biological scum of problematic proportions in activated sludge plants is widespread. The causative organisms in Southern African plants have been identified as members of the Nocardia and Microthrix species. When causing scum problems, these organisms have the property to be selectively separated from the settleable activated sludge floc by a process of selective flotation. By applying the process of selective flotation a quantitative method for the determination of biological scum has been developed. This method was used to compare the scum intensity of different activated sludge plants and to evaluate the efficiency of scum removal upon treatment. Pilot scale studies were undertaken to evaluate the process of selective flotation as a simple practical method for the control of scum forming microorganisms in activated sludge plants. More than 95f% of the scum forming microorganisms were removed within the first few hr indicating that for practical purpose the flotation time could be limited to 4 hr without seriously impeding the results. (Lantz-PTT)
W88-04383

INFLUENCE OF NITRILOTRIACETATE ON THE ELIMINATION OF METAL IONS BY CO-PRECIPITATION WITH FERRIC HYDROXIDE,
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
F. H. Frimmel, and J. Geywitz.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 1013-1019, 1987. 5 fig, 3 tab, 15 ref.

Descriptors: *Chemical wastewater treatment, *Nitriloacetate, *Heavy metals, *Ferric hydroxide, *Wastewater treatment, Copper, Zinc, Cadmium, Lead, Iron.

The elimination of dissolved copper, zinc, cadmium and lead by coprecipitation with iron(III) hydroxide was investigated. The reaction conditions of the batch experiments were adopted from water treatment. Conditional distribution coefficients show the order $Cd < Zn < Cu < Pb$ for increasing interaction of the metals with the ferric hydroxide. The presence of nitrilotriacetate (NTA) decreases the efficiency of the metal elimination. NTA is also able to remobilize metals from the metal enriched precipitation. There is a significant effect, even at low concentrations of a few micromol/L. Remobilization of Cu, Zn and Cd increases, remobilization of Pb decreases with reaction time. The 'aging' of the precipitation plays an important role for the yield of the reactions. From a broad application of NTA in detergents an increase of the concentration of dissolved metal species has to be expected. (Author's abstract)
W88-04384

KINETICS OF CADMIUM AND COPPER HYDROLYSIS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
J. W. Patterson, C. N. Haas, R. J. Vamos, and E. Cooney.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 1021-1027, 1987. 4 tab, 8 ref.

Descriptors: *Kinetics, *Wastewater treatment, *Cadmium, *Copper, *Hydrolysis, Heavy metals, Chemical precipitation, Electrolysis, Chemical reactions.

It has been suggested that Kinetic limitations are significant in the regulation of metal removal by precipitation processes. However, there have been

no direct measurements on rates of such processes with the environmentally more significant metals. Homogeneous complexation rates of cadmium and copper with hydroxide in a complete mix continuous flow reactor were measured using ion specific electrodes. The equilibrium constants for the formation of the mono-hydroxy cadmium and copper complexes were determined experimentally to be 10.17 and 6.80. Kinetic data were gathered for the cadmium-hydroxy system over a pH range of 8.73 to 9.9, and a range of total cadmium concentration from 3.9E-04 to 6.5E-06 M. The data obtained were consistent with a kinetic model with a forward term which was overall second order and first order in each of cadmium and hydroxide, and a reverse term which was first order with respect to the complex concentration. The forward rate constant was estimated as 6,519 (L/mol/sec) and the reverse rate constant was estimated as 0.7516 (per sec). (Lantz-PTT)
W88-04385

UPPER JAMES ESTUARY - A STUDY IN WATER QUALITY MANAGEMENT,
Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 5G.
W88-04412

INTEGRATED WATER DEVELOPMENT PROJECT OF GRAVATAI RIVER BASIN, BRAZIL,
Departamento Nacional de Obras de Saneamento, Porto Alegre (Brazil).
For primary bibliographic entry see Field 6B.
W88-04418

OPTIMIZATION OF REGIONALIZED WASTEWATER TREATMENT SYSTEMS FOR THE RIVER AVE BASIN,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
A. S. Camara, J. J. de Melo, and D. F. Pereira.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 175-182, 1987. 3 fig, 2 tab, 7 ref.

Descriptors: *Computer models, *Ave River, *Wastewater treatment, *Algorithms, *Water pollution sources, *Model studies, *Water quality management, Stream pollution, Rivers, Models, Cost analysis, Textile mill wastes, Industrial wastes, Optimization, Computers.

A new methodology to optimize regionalized wastewater treatment systems is presented. The model, named STAR 1 attempts to efficiently solve two of the most significant difficulties of the problem: the combinational diminsion and the concavity of the cost functions. The approach, developed for the River Ave basin, relies upon a clustering analysis algorithm to identify independent subsets of polluting sources within the basin. Then for each cluster, heuristic methods are used to generate a network representing the most promising configurations for the regional system, auxiliary models are applied to estimate detailed costs, and a k-shortest path algorithm is used to specify the configurations minimizing cost while achieving a pre-defined efficiency level. To illustrate the proposed method, an application to a sub-section of the basin with seven textile industry units is included. (Author's abstract)
W88-04429

SOCIO-ECONOMIC DEVELOPMENT LEVELS AND ADEQUATE TECHNOLOGICAL POLICY FOR WATER RESOURCES MANAGEMENT,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 237-256, 1987. 29 fig, 3 tab, 10 ref.

Descriptors: *Water management, *Water supply, *Wastewater treatment, *Wastewater disposal, *Water pollution control, Rural areas, Water policy, Sludge disposal, Land disposal, Sludge drying, Sewer systems, Economic aspects, Cost analysis, Biological wastewater treatment.

Depending on the population density and economic status of an area, different technologies for wastewater disposal have been developed in West Germany. In rural areas, water is supplied by local wells, with houses partly connected. No sewerage is available and wastewater treatment is by pit latrines, septic tanks and soil infiltration. Water pollution control consists of protecting drinking water wells. In developing areas, water is supplied from a central point with houses partly connected and with partial sewerage. Wastewater treatment is by ponds, oxidation ditches or land treatment. Water pollution control involves the protection of drinking water wells. In highly developed areas water is centrally supplied with houses connected. Combined or separated sewers are used, and wastewater treatment is by trickling filters or activated sludge with tertiary treatment. Water pollution control endeavors include river basin management, water treatment and disinfection. Costs of sewer systems vary depending on population density, geology, type of sewerage, depth, and dimension of the sewer. The most economical method of sludge disposal is the spreading of liquid sludge onto farm land. The next cheapest method is sludge lagooning. Wastewater treatment plants can be upgraded by simultaneous precipitation with iron salts in the activated sludge tanks to eliminate phosphorus and by polishing lagoons. River basin management can help to achieve better water quality at lower costs. (Geiger-PTT)
W88-04437

STRENGTH OF ALUMINIUM HYDROXIDE FLOCS,
British Aerospace Aircraft Group, Kingston upon Thames (England).
For primary bibliographic entry see Field 5F.
W88-04441

ADSORPTION OF HEAVY METALS ONTO HYDROUS ACTIVATED CARBON,
Delaware Univ., Newark. Dept. of Civil Engineering.
M. O. Corapcioglu, and C. P. Huang.
Water Research WATRAG, Vol. 21, No. 9, p 1031-1044, September, 1987. 9 ref, 2 tab, 35 ref.
U.S. EPA Grant 808141.

Descriptors: *Chemical reactions, *Heavy metals, *Adsorption, *Wastewater treatment, *Water treatment, *Activated carbon, Hydrogen ion concentration, Models, Separation techniques, Temperature effects, Copper, Lead, Nickel, Zinc, Absorption, Load distribution, Chemical wastewater treatment.

The absorption characteristics of some heavy metals, namely Cu, Pb, Ni and Zn onto the hydrous activated carbon surface are studied. Carbon type, pH and surface loading are the most important factors affecting the extent of metal removal. The adsorption reaction can be best described by a surface complex formation model. The free metal ions, M(2+), and their hydroxo species all participate in the absortpion reaction. Specific chemical bonding, probably hydrogen bonding provided the sole energy needed for adsorption reaction; approximately 4 kcal/mol/bonding. (Author's abstract)
W88-04442

SULFIDE AND SULFATE INHIBITION OF METHANOGENESIS,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
P. P. Karhadkar, J.-M. Audic, G. M. Faup, and P. Khanna.
Water Research WATRAG, Vol. 21, No. 9, p 1061-1066, September, 1987. 4 fig, 7 tab, 12 ref.

Descriptors: *Sulfides, *Sulfates, *Methane, *Wastewater treatment, *Anaerobic digestion, Industrial wastewater, Methane bacteria, Molybdenum, Heavy metals, Bioassays, Hydrogen sulfide.

The inhibition potential of sulfide and sulfate in the methanogenesis of synthetic distillery wastes was investigated using biological assays under identical laboratory conditions. Methanogenesis was progressively inhibited with the increase in sulfide concentration in the substrate. Inhibition was related to H2S concentration in the evolved gas and could, accordingly, be used as an indicator of inhibition in methanogenesis; inhibition of 50% was observed at 5% H2S in the evolved gas. Methanogenesis was not inhibited by sulfate up to 5000 milligrams/liter, due to the high substrate availability indicated by a 1.33 molar ratio of TOC to sulfate. The effect of molybdate on methanogenesis in the presence of sulfate is also investigated. Sulfate reduction and methanogenesis are both inhibited in the presence of 20 mM molybdate. (Author's abstract)
W88-04445

GUIDELINES FOR THE MINIMUM EVALUATION OF THE PERFORMANCE OF FULL-SCALE WASTE STABILIZATION POND SYSTEMS,
Liverpool Univ. (England). Dept. of Botany.
H. W. Pearson, D. D. Mara, and C. R. Bartone.
Water Research WATRAG, Vol. 21, No. 9, p 1067-1075, September, 1987. 4 fig, 2 tab, 16 ref, 3 append.

Descriptors: *Stabilization ponds, *Wastewater treatment, Stabilization lagoons, *Performance evaluation, Optimization, Monitoring, Wastewater analysis, Effluents, Developing countries, Wastewater management, Seasonal variation, Chemical analysis.

Guidelines are presented for the minimum evaluation of the performance of existing full-scale waste stabilization ponds. It is recommended that 24-hour flow-weighted composite samples of raw wastewater and pond effluents be taken over a 5 week period at the hottest and coldest periods of the year, and analyzed for BOD, COD, SS, NH3-N, NO3-N and total P. Fecal coliform numbers should be determined on grab samples, and algal biomass estimated by measuring chlorophyll concentrations in samples of the pond water column. Pond mid-depth mean daily temperatures and pond sludge depths should also be measured, and local meteorological data obtained. The diurnal variation of pond effluent quality and of dissolved oxygen and temperature with depth should be measured at least once during each sampling season. Recommendations are given for a more simplified estimate of pond performance in areas where the lack of skilled manpower, materials and equipment preclude the complete minimum evaluation procedure. (Author's abstract)
W88-04446

PREDICTING OPTIMUM BACKWASH RATES AND EXPANSION OF MULTI-MEDIA FILTERS,
Sheffield City Polytechnic (England). Dept. of Civil Engineering.
B. A. Quaye.
Water Research WATRAG, Vol. 21, No. 9, p 1077-1087, September, 1987. 3 fig, 2 tab, 7 ref.

Descriptors: *Filters, *Water treatment, *Wastewater treatment, Sand filters, *Filtration, *Backwash, Porosity, Hydraulic models, Theoretical analysis, Mathematical models, Settling velocity.

A new model for predicting the optimal expansion of dual and tri-media beds was developed and tested experimentally. The model is used to determine the height of filter weirs necessary to prevent the loss of filter media during backwash. The heuristic assumption for predictina the exact expansion the multi-layer filter beds stated that the ratios of the porosities of tightly compacted beds and the porosities of the expanded beds are equal, and verified theoretically. From the theoretical and experimental study of the optimum backwash of sand and multilayer filters, it is concluded that the optimum porosity of the expanded medium in the transition regime lies between 0.600 and 0.800. The maximum shear in the fluid for optimum cleaning of anthracite-flintag-alundum media occurs at as optimum expanded porosity of 0.750, 0.780 and 0.780, respectively. Backwashing of deep granular filter beds with an upflow wash rate less than the optimum, resulted in the accumulation of suspend-

ed solids in the filter pores after a period of filter operation. (Geiger-PTT)
W88-04447

EVALUATION OF SOLUBLE AND INSOLUBLE XANTHATE PROCESS FOR THE REMOVAL OF HEAVY METALS FROM WASTEWATERS,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
V. Tare, and S. Chaudhari.
Water Research WATRAG, Vol. 21, No. 9, p 1109-1118, September, 1987. 11 fig, 6 tab, 21 ref.

Descriptors: *Xanthate process, *Heavy metals, *Wastewater treatment, *Chemical precipitation, Cadmium, Starch, Separation techniques, Chromium, Chemical wastewater treatment, Sorption, Adsorption, Hydrogen ion concentration, Starches.

The effectiveness of the xanthate (water soluble and water insoluble) process for hexavalent chromium removal was evaluated. Insoluble xanthates were synthesized in the laboratory from corn starch (ICSX), potato starch (IPSX) and cellulose powder (ICX), and their removal efficiency for Cr(VI) is compared with soluble starch xanthate (SSX). In preliminary experiments various insoluble xanthates were tested for their effectiveness in removing both the metallic cation, Cd(II), and metallic anion (chromate). Comparison between ICSX and SSX revealed that ICSX has a better removal capacity for Cr(VI) on a unit weight basis. However, based on chemical requirements for the synthesis of ICSX and SSX, SSX appears to be better than ICSX. The removal of Cr(VI) decreased with and increase in pH, while the ionic composition of the aqueous phase had little effect on the removal of both soluble and insoluble xanthates. The removal mechanism for Cr(VI) appears to be the reduction and complexation of reduced chromium with xanthate groups. A comparative analysis of the traditional reduction-precipitation process and xanthate process for hypothetical waste containing hexavalent chromium, revealed that the xanthate process is a worthwhile alternative. (Author's abstract)
W88-04450

PREDICTION OF ORGANIC CHEMICAL FATES IN BIOLOGICAL TREATMENT SYSTEMS,
Tennessee Univ., Knoxville. Energy, Environment and Resources Center.
J. W. Blackburn.
Environmental Progress ENVPDI, Vol. 6, No. 4, p 217-223, November 1987. 7 fig, 2 tab, 14 ref.

Descriptors: *Biological wastewater treatment, *Fate of pollutants, *Organic compounds, Organic carbon, Biological oxygen demand, Chemical oxygen demand, Biotransformation, Wastewater treatment, Biomass.

Attention is presently being focused on the fates of organic chemicals in biological treatment systems. Most systems have been designed and operated to remove organic compounds from the aqueous waste stream and performance has been defined in terms of removal of a nonspecific parameter from the wastewater. Parameters like total organic carbon, biochemical oxygen demand, and chemical oxygen demand have historically been used in treatability studies, in system design, and in determining system performance. Performance data using these approaches are inadequate for determination of the removal of specific compounds unless (fortuitously) the specific compound's biological activity is approximated by the generalized activity of the non-specific parameter. The resulting assumption that the biokinetics, and therefore the fate of organic compounds, are similar and well-described by the biokinetics of the non-specific parameter does not hold for specific chemicals that possess strong stripping/volatilization and/or biomass sorption tendencies or for compounds that have biotransformation kinetics that differ from the idealized 'BOD-like' compound. Some compounds are likely to preferentially strip/volatilize or sorb onto biomass either if generally recalcitrant to biotransformation, or if the biotransformation process is variable and the rates of the competitive fate mechanisms are large relative to the low transient biotransformation rate. The biotransformation rates have the greatest magnitude of variation of any fate-related parameter and therefore have a major influence on the compound fate. An equation coupling the competitive fates of organic chemicals in completely mixed and steady-state biological treatment systems have been developed and are presented. This equation can be arranged to allow calculation of the fraction or percentage of an organic compound fed to a system that strips, sorbs onto biomass, biotransforms, or remains in the effluent if the stripping, sorption, and biotransformation rates are known. It can be used to correct experimental data to account for the competitive mechanisms and generate more reliable biotransformation data. Finally, it also serves as a unifying approach against which the specific fate performance of a given system may be compared. Therefore it may be used to estimate potential organic air emissions and the potential of toxic organics in sludge generated from the biological waste treatment process. (Author's abstract)
W88-04469

OZONOLYSIS OF ORGANIC COMPOUNDS IN A TWO-PHASE FLUOROCARBON-WATER SYSTEM,
Kentucky Univ., Lexington. Dept. of Chemical Engineering.
F. A. Stich, and D. Bhattacharyya.
Environmental Progress ENVPDI, Vol. 6, No. 4, p 224-229, November 1987. 9 fig, 1 tab, 19 ref.

Descriptors: *Toxic wastes, *Ozonolysis, *Organic compounds, *Ozonation, *Wastewater treatment, *Fluorocarbons, Ozone, Chemical reactions, Chemical wastewater treatment, Phenol, Naphthol, Hydrogen ion concentration, Organic carbon, Liquid chromatography, Chemical analysis.

Ozone, due to its characteristics as a powerful oxidant, has found use in the destruction of toxic organic compounds in wastewater. Its use has been limited however, because of ozone's rapid decomposition and low solubility in water. The ozonation process may be more efficiently carried out in a two-phase system. The second phase consists of a reusable, fluorinated hydrocarbon, with an ozone solubility of 12-14 times that of water. The fluorinated solvent serves as both an ozone source and a non-aqueous phase in which the oxidation occurs. With this novel two-phase process, it is also possible to perform selective oxidation. The experimental results are presented for organic compounds such as phenol, naphthol, etc. The extent of degradation is measured in terms of pH changes, HPLC, and TOC. (Author's abstract)
W88-04470

REMOVAL OF DISSOLVED ORGANIC CONTAMINANTS BY OZONATION,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. Yurteri, and M. D. Gurol.
Environmental Progress ENVPDI, Vol. 6, No. 4, p 240-245, November 1987. 8 fig, 1 tab, 11 ref, append. EPA Agreement No. R-811128-01.

Descriptors: *Wastewater treatment, *Dissolved solids, *Ozonation, Chemical wastewater treatment, Water treatment, Ozone, Simulation analysis, Mathematical models, Model studies, Organic compounds, Oxidation, Chemical reactions.

The use of ozone for the elimination of dissolved organic pollutants from water and wastewaters, is the focus of this paper. The physical and chemical phenomena prevailing during the contact of a polluted liquid stream with gaseous ozone-air or ozone-oxygen mixture in empty or packed columns is represented mathematically. The simulation procedure is based on defining the concentration profiles of ozone and the organic solutes in both liquid and gas phases by means of differential mass balances. Methods for the determination of necessary model parameters is outlined and the model is analyzed for its sensitivity to various process variables. Major mechanisms contributing to the removal of organic pollutants in ozone reactors are stripping and total oxidation (direct plus indirect). The following factors were found to influence the overall removal efficiency: (1) chemical reactivity of the organic compound, expressed as the total oxidation rate constant; (2) volatility of the organics, indicated by the Henry's Law constants; (3) contact opportunity between the phases measured by the volumetric mass transfer coefficients; (4) gas-to-liquid ratio, which together with the bed characteristics, determines the contact time; and (5) influent ozone concentration in the gas phase, which together with the chemical composition of water, quantified as w, and mass transfer properties, determines the available bulk ozone concentration at any given column section. (Lantz-PTT)
W88-04471

INTERMEDIA TRANSPORT OF ORGANIC COMPOUNDS IN BIOLOGICAL WASTEWATER TREATMENT PROCESSES,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Medford, MA.
D. A. Barton.
Environmental Progress ENVPDI, Vol. 6, No. 4, p 246-256, November 1987. 7 fig, 8 tab, 39 ref.

Descriptors: *Solute transport, *Organic compounds, *Biological wastewater treatment, *Path of pollutants, Volatilization, Sorption, Biodegradation, Model studies, Mathematical models, Aeration.

Organic compounds present in many industrial effluents are transported to varying extents to the gaseous or solid phase, in addition to potential biodegradation, during treatment. Knowledge of the fate of such compounds is critical for making valid policy and engineering decisions regarding issues such as the disposal of sludges, effluent toxicity, and emissions to the ambient air. To quantify the relative distribution of the fate of selected groups of compounds, a mathematical model was developed to describe the intermedia transport mechanisms including volatilization, solids sorption, and biodegradation. The extent of removal via each modeled pathway is a function of the physical properties of the specific compound and the process design and operational parameters of the system. The following observations were made from this examination: (1) Transport to the solids phase is significant for the compounds with octanol-water partition coefficients greater than 5 L/gm; (2) Biodegradation can be a significant removal pathway for some compounds with low octanol-water partition coefficients and low Henry's constants, such as phenol; (3) Natural volatilization across the surface of ASB processes is only significant for compounds with Henry's constants in the range of 0.0001 to 0.01 atm-cu m/mole where the basin is aerated with subsurface aeration devices; (4) Forced stripping via surface aeration can potentially provide greater than 85% removal of 50% of seventy priority pollutant compounds for which Henry's constants are available; (5) Based on the use of this model, between 15 and 30% of seventy-four priority pollutants for which octanol-water coefficients are available can be expected to be transferred in significant quantities to the solids phase via sorption during biological wastewater treatment; and (6) Comparison of predicted chloroform removal with measured removals in conventional activated sludge and ASB processes suggests that overall chloroform removal is accurately predicted by the model for these two types of processes under the conditions of comparison used here. (Lantz-PTT)
W88-04472

5E. Ultimate Disposal Of Wastes

REDUCTION OF MICROBIAL INDICATORS AND VIRUSES IN A CYPRESS STRAND,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W88-03559

DISINFECTION EFFICIENCY AND PROBLEMS ASSOCIATED WITH MATURATION PONDS,
State Pollution Control Commission, Lidcombe (Australia).
For primary bibliographic entry see Field 5D.
W88-03561

SURVIVAL AND TRANSPORT OF HEPATITIS A VIRUS IN SOILS, GROUNDWATER AND WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W88-03570

EPIDEMIOLOGICAL MODEL OF THE POTENTIAL HEALTH RISK ASSOCIATED WITH VARIOUS PATHOGENS IN WASTEWATER IRRIGATION,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W88-03581

PROSPECTIVE EPIDEMIOLOGICAL STUDY OF HEALTH RISKS ASSOCIATED WITH WASTEWATER UTILIZATION IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W88-03582

CASE STUDIES IN CO-COMPOSTING, BY E. EPSTEIN.
E. Epstein.
BioCycle BCYCDK, Vol. 28, No. 3, p 24-26, March 1987. 4 fig, 1 tab.

Descriptors: *Co-composting, *Composting, *Wastewater treatment, *Sludge, *Massachusetts, *Waste disposal, *Sludge composting, *Sludge treatment, *North Carolina, *Case studies, *Solid wastes, Wastewater, Technology, Economics, Cost analysis, Cost-benefit analysis, Sludge disposal, Metals, Recycling, Fuel, Environmental sanitation.

Co-composting of sewage sludge is a well-established technology and widely practiced in European countries. The advantages of co-composting are: reduced cost of sludge composting by using the solid waste as bulking agent; incorporation of diverse waste streams; lower capital costs than most alternative technologies; and combining the cost of sludge and solid waste disposal. Other advantages include: process flexibility through modular construction; reduced volume and mass of solid waste to landfills; good environmental control; marketable products can be produced; and compatibility with recycling. The three main elements of co-composting are: preprocessing; composting; and postprocessing. (Main-PTT)
W88-03594

ASSESSING RISK OF SOLID WASTE COMPOST,
Wisconsin Univ.-Stevens Point.
For primary bibliographic entry see Field 5C.
W88-03595

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART III-OXYGEN, MOISTURE, ORDOR, PATHOGENS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W88-03596

WINTER APPLICATION OF SLUDGE,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
L. M. Naylor, R. Guest, J. A. Johnson and, and C. R. Baker.
BioCycle BCYCDK, Vol. 24, No. 3, p 46-48, March 1987. 13 ref.

Descriptors: *Sludge disposal, *Land disposal, *Environmental protection, *Agricultural runoff, *Water pollution control, *Wastewater disposal, *Runoff, Manure, Soil amendments, Regulations, Legal aspects, Water pollution, Nutrients, Cropland, Heavy metals, Water quality control, Crop yield, Fate of pollutants, Poultry.

Land application disposal methods were examined as an economic means of disposing secondary wastewater sludge containing food processing residuals from a poultry processing facility during winter. Wastewater residuals contained 0.5% solids with 11% nitrogen, 2% phosphorous, 0.75% potassium, and acceptable levels of essential and nonessential trace minerals. The residuals were applied to bermed application cells at rates of 0, 8,000 16,000, 32,000 and 56,000 gallons per acre. The solids application rates were 0, 0.2, 0.4, 0.6 and 1.1 dry tons per acre. Residuals were absorbed by snow or into the soil within 30 minutes following application. Differences in hay yield and quality were minor among treatments. All treated cells produced greater yields than the control. Winter application of residuals can be, under a carefully controlled and well-managed program to avoid runoff, an environmentally sound management practice. (Main-PTT)
W88-03597

MOUNT HOLLY MAKES A BUSINESS OUT OF SLUDGE PROCESSING,
Mount Holly Sewerage Authority, NJ.
W. G. Dunn, and D. E. Baril.
Water Engineering and Management, Vol. 134, No. 4, p 30-32, April 1987.

Descriptors: *Sludge, *Sludge disposal, *Wastewater treatment facilities, *Odor control, *Mount Holly, Economic aspects, Sand filters, Effluents, New Jersey, Industrial wastes, Leachates, Regulations, Landfills, Sludge solids, Sampling, Toxicity, Oxidation, Dye industry wastes, Water quality standards.

At Mount Holly, New Jersey, the local sewerage authority accepts sludge, septage, leachate and non-hazardous industrial wastes from other treatment plants and generators in the area, and thermally processes it with its own. The practice of receiving and processing off-site material was the result of excess capacity in Mount Holly's sludge processing plant, and new sludge disposal regulations established by the New Jersey Department of Environmental Protection. To increase efficiency, procedures for sampling off-site solids; receiving the material; dealing with increased odors from tipping and receiving; and handling the impact of the additional material on plant processes have been developed. discharge quality has remained excellent. BOD removal rates are generally above 98%. Preliminary treatment through rehabilitated trickling filters and subsequent powdered carbon adsorption in the biological treatment process preserve the quality of the final discharge. Tertiary rapid sand filters provide a backup when needed. The fee schedule is based on the solids content and type of material to be processed. Processing off-site sludge has been successful at Mount Holly, and is a source of revenue that offsets some of the operating costs. (Main-PTT)
W88-03603

DENVER'S LONG DISTANCE RAW SLUDGE TRANSFER PAYS OFF,
Metropolitan Denver Sewage Disposal District No. 1, CO.
M. C. Wong.
Public Works PUWOAH, Vol. 118, No. 4, p 47-49, April 1987. 1 fig.

Descriptors: *Sludge transfer, *Denver, Colorado, *Economic aspects, *Methane, *Gasification, *Sewage sludge, *Planning, *Pumping, Pipeline, Pumps, Laminar flow, Valves, Flow, Flow monitoring.

The Denver Sewage Disposal District initiated an engineering study to determine the feasibility of transferring all primary sludge from the Denver Northside Plant (DNS) through an existing 1.6-mile pipeline system to the Central Plant for anaerobic digestion until the Central Plant expansion is completed. The transfer of raw sludge from DNS to the Central Plant would allow discontinuation of DNS digestion operations, reducing its operations and maintenance costs, and would produce more methane gas at the Central Plant. Cost of the sludge transfer system was estimated at $50,000 while total benefits would be approximately $500,000. Two progressive cavity pumps were specified, a high-low level switch was installed in the DNS center well, a flow switch was installed in the suction port of each pump, and a pressure sensor was installed in the common discharge line to shut off the motor if the pressure in the sludge line exceed 125 psi. Preliminary data show that the additional gas generated from the DNS raw sludge transfer project is worth approximately $600 a day. (Main-PTT)
W88-03633

DISPOSAL OF ACID-BEARING AND ACID-GENERATING SLUDGES IN THE FERTILIZER MANUFACTURING INDUSTRY,
Smith, Adrian Consulting, Inc., North Vancouver (British Columbia).
A. Smith.
Canadian Journal of Civil Engineering CJCEB8, Vol. 14, No. 1, p 1-6, February 1987. 10 ref.

Descriptors: *Chemical wastes, *Waste disposal, *Fertilizer industry, *Sludge disposal, *Industrial wastes, Fertilizers, Phosphogypsum, Acid sludge, Calcine.

Major waste products from fertilizer manufacture are calcine and so-called phosphogypsum, calcium sulfate. The oxidation and leaching of calcine produces a liquid with a strong acidity and hence is acid generating. Disposal of phosphogypsum, an acidbearing waste, is normally effected by construction of a tailings impoundment, similar in nature to those utilized for tailings disposal in the mining industry. This paper adrresses the general chemistry, pollution potential, and chemical attack potential of both calcine and phosphogypsum and the impact these have on their disposal. The similarities and differences in the design philosophy for acid-bearing and acid-generating waste facilities are then discussed. (Author's abstract)
W88-03639

MODEL TEST OF A PUMPING STATION WET WELL,
MacLaren Plansearch, Inc., Toronto (Ontario).
For primary bibliographic entry see Field 5D.
W88-03640

SWEDISH FIELD EXPERIENCES WITH CHEMICAL PRECIPITATION IN STABILIZATION PONDS,
Luleaa Univ. (Sweden).
For primary bibliographic entry see Field 5D.
W88-03641

PRESENT STATE AND FUTURE DIRECTION OF COUNTERMEASURES FOR POLLUTION FROM DOMESTIC WASTEWATER IN JAPAN,
Environment Agency, Tokyo (Japan). Water Pollution Control Div.
For primary bibliographic entry see Field 5D.
W88-03702

TREATMENT AND REUSE OF HUMAN WASTES, AND THE PRESENT STATE OF WATER RESOURCES, IN CHINA,
Chinese Society of Environmental Science, Beijing (China).
For primary bibliographic entry see Field 5D.
W88-03703

NIGHT SOIL TREATMENT IN KOREA,
Yeungnam Univ., Gyeongbug (Republic of Korea). Dept. of Urban Engineering.

For primary bibliographic entry see Field 5D.
W88-03704

DOMESTIC WASTEWATER TREATMENT AND DISPOSAL IN THE PHILIPPINES,
For primary bibliographic entry see Field 5D.
W88-03705

TOWARD AN AFFORDABLE HUMAN WASTE MANAGEMENT PROGRAMME FOR THE POOR - A REPORT ON BANGLADESH,
Department of Public Health Engineering, Dacca (Bangladesh).
For primary bibliographic entry see Field 5D.
W88-03706

MANAGEMENT OF HOUSEHOLD HUMAN WASTE IN JAPAN,
Ministry of Health and Welfare, Tokyo (Japan).
For primary bibliographic entry see Field 5D.
W88-03707

SANITATION PROGRAM DEVELOPMENT FOR RURAL THAILAND IN RELATION TO THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-03708

EVOLUTION OF LOW TECHNOLOGY WASTE WATER DISPOSAL IN THE DEVELOPED COUNTRIES AND ITS IMPLICATION FOR THE DEVELOPING NATIONS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-03709

INTERNATIONAL COOPERATION FOR THE IMPROVEMENT OF ENVIRONMENTAL SANITATION BY JAPAN,
Ministry of Health and Welfare, Tokyo (Japan).
For primary bibliographic entry see Field 5D.
W88-03711

NORTH AMERICAN AND EUROPEAN EXPERIENCE WITH BIOLOGICAL TOILETS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W88-03714

BASIC CONCEPTS AND PROCEDURES FOR THE IMPROVEMENT OF SOLID WASTE MANAGMENT IN URBAN FRINGE AREAS,
Japan International Cooperation Agency, Tokyo (Japan).
K. Sakurai.
Water Science and Technology WSTED4, Vol. 18, No. 7/8, p 113-120, 1986. 1 fig, 1 tab.

Descriptors: *Pollution control, *Water pollution control, *Solid waste disposal, *Waste disposal, Solid wastes, Public health, Urban areas, Urban planning, Urban sociology.

Improvement of basic sanitation including solid waste management is an urgent need in urban fringe areas of developing countries. The research and development of non-conventional solid waste management systems for these areas has been carried out in large Latin American cities because the conventional door-to-door collection technology is not applicable for technical, economic and sociocultural reasons. The basic concepts and procedures for the improvement of solid waste management in urban fringe areas are clear. Due to the rapid transition of these areas in quantitative and qualitative terms, the necessity of further active discussions on this theme based on practice is concluded. For example, some technologies which may have been appropriate for the first generation who migrated from rural areas may not be appropriate for the second and third generation who have become accustomed to urban life. It may be more practical to consider such technologies as transitorily appropriate. (Author's abstract)
W88-03716

PEOPLE WHO GET IN THE WAY: CHANGING VALUES IN URBAN WASTE MANAGEMENT,
York Univ. (England). Inst. of Social and Economic Research.
For primary bibliographic entry see Field 5D.
W88-03717

GENERAL REVIEW AND NEW CONCEPTS REGARDING THE DEVELOPMENT OF HUMAN WASTEWATER TREATMENT IN JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5D.
W88-03719

PROLONGED EFFECT OF LAND DISPOSAL OF HUMAN WASTES ON SOIL CONDITIONS,
National Research Centre, Cairo (Egypt).
For primary bibliographic entry see Field 5D.
W88-03744

USE OF SOIL FOR DISPOSAL OF DOMESTIC SEWAGE,
Ebara Research Co. Ltd., Fijisawa (Japan).
For primary bibliographic entry see Field 5D.
W88-03745

ASPECTS OF LAND DISPOSAL OF WASTEWATER AS EXPERIENCED IN GERMANY,
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Stadtbauwesen.
For primary bibliographic entry see Field 5D.
W88-03746

TREATED SEWAGE FINDS FRUITFUL USE,
For primary bibliographic entry see Field 3C.
W88-03815

COMPOSTING'S EMERGING ROLE IN SLUDGE MANAGEMENT: A NATIONAL PERSPECTIVE,
Black and Veatch, Denver, CO.
R. D. Kuchenrither, D. M. Diemer, W. J. Martin, and F. J. Senske.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 3, p 125-131, March 1987. 3 fig, 2 tab, 4 ref.

Descriptors: *Sludge disposal, *Composting, *Wastewater treatment facilities, *Philadelphia, *Denver, *Oakland, Land disposal.

Use of composting as a potential sludge management tool, previously limited to small-scale wastewater treatment facilities is now finding wider acceptance. This is primarily due to increasing public and regularity pressures to lessen the availability of landfills and oceans for sludge disposal. Three large facilities located in Philadelphia, Pa., Denver, Colo., and Oakland, Calif., demonstrate this new trend. The Philadelphia facility is expected to be completed in January 1988. This 32 million dollar facility includes: scales and scale house, mixing and receiving building, 64,000 sq ft compost drying structure, one acre screening area, operation and maintenance center, 18-acre composting area with semi-permanent aeration system and areas for wood chip and compost storage. This facility, with its maximum daily capacity of 405 dry tons of sludge, is the largest in USA. The sludge compost products are used in four programs: marketing, bulk application, strip mine reclamation. and giveaway. Use of the compost in Garden State Race Track, Keystone Raceway, hotels in Atlantic City, NJ, golf courses and other areas point to the success of the marketing effort by the city of Philadelphia. Other bulk uses are in farmlands both in Pennsylvania and New Jersey. Of the four usages of compost sludge strip mine reclamation is the most costly. The Denver facility put into service in June 1986 has a capacity of 100 dry tons per day. The high-grade finished compost sells for $12-16 per cu yd delivered. Market study indicates the demand for this product will be five times greater than supply. The Oakland facility grew out of the original 1944 treatment plant. The present plant, a six-acre facility, started operation in July 1983 and at present produces 17 tons per day of dry compost. The marketing study indicates that sales revenues of $6-$9/cu yd are achievable. (Ray-PTT)
W88-03828

RHIZOSPHERE MYCOFLORA OF GROUNDNUT GROWN IN SEWAGE AND SLUDGE TREATED SOILS,
Marathwada Univ., Aurangabad (India).
L. V. Gangawane, and L. Kulkarni.
Indian Phytopathology IPHYAU, Vol. 38, No. 4, p 756-757, December 1985. 1 tab, 5 ref.

Descriptors: *Wastewater irrigation, *Sludge disposal, *Soils, Rhizoplane, Land disposal, Fungi, Agriculture, Domestic wastes, Groundnut.

The microbial changes in the root areas of groundnut grown in sewage and sludge treated soils were studied. Experiments were carried out in earthenware pots completely filled with activated sludge and normal field soil (1:1). Other pots were filled with sandy loam soil collected from fields irrigated with well water. These pots were than irrigated with domestic untreated sewage. Control pots contained the above sandy-loamed soil and were irrigated with tap water. A total of 22 species of fungi were observed during the growth period of groundnut plants. A higher number of species was found in sewage-treated soils (17) than in sludge-treated soils (14) as against only 13 in untreated soils (control). These differences in the rhizoplane mycoflora can be attributed to the direct effect of different constituents present in the sewage or sludge or indirectly to the changes in root exudate pattern of the plants. (Ray-PTT)
W88-03846

MONITORING AND STUDY PROGRAM OF AN INTERREGIONAL WASTEWATER RECLAMATION SYSTEM FOR AGRICULTURE,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 3C.
W88-03851

RECYCLING TO REDUCE SEDIMENT DISCHARGE IN PLACER MINING OPERATIONS,
Alaska Univ., Anchorage.
For primary bibliographic entry see Field 5D.
W88-03855

HEAVY METALS IN SOIL FROM LAND RECLAMATION WITH SLUDGE,
Indiana Univ. of Pennsylvania.
S. L. Tackett, and A. M. Yadvish.
Journal Water Pollution Control Federation JWPF5, Vol. 59, No. 5, p 294-298, May 1987. 4 tab, 14 ref.

Descriptors: *Sludge disposal, *Heavy metals, *Municipal sludge, *Land reclamation, *Strip-mine land, *Somerset county, Pennsylvania, Lead, Copper, Zinc.

Municipal sludge has been used in Somerset county, Pa., as a fertilizer for reclaiming strip-mined land. Although the effects of sludge use on cropland, including build-up of heavy metals in soil are known, the long term effects of municipal sludge in strip-mined land is not known. There is a potential for greater heavy metal build-up in strip-mined than in cropland, because sludges with higher metal concentrations are permitted for mine land reclamation and more sludge is applied per acre for reclamation purposes. Also strip-mined land tends to be more porous than agricultural land. There was a definite increase in lead, copper, and zinc concentrations in the soil following the

land application of sludge. Although the actual concentrations of the three metals varied widely from place to place in the fields, their average values showed a distinct relationship between the metal build-up in the soil and the metal concentration in the sludge. Cadmium concentration varied in the soil samples but the average was not significantly higher than non-sludged soils. A disturbing aspect of this research, was the finding that most of the sites reclaimed with sludge are now used for farming. (Ray-PTT)
W88-03858

EXTRACTABILITY AND BIOAVAILABILITY OF ZINC, NICKEL, CADMIUM AND COPPER IN THREE DANISH SOILS SAMPLED 5 YEARS AFTER APPLICATION OF SEWAGE SLUDGE,
Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
J. R. Sanders, T. M. Adams, and B. T. Christensen.
Journal of the Science of Food and Agriculture JSFAAE, Vol. 37, No. 12, p 1155-1164, Dec. 1986. 1 fig, 8 tab, 18 ref.

Descriptors: *Zinc, *Nickel, *Cadmium, *Copper, *Barley, *Beet, *Sludge, *Sludge disposal, *Land disposal, Metals, Bioaccumulation, Denmark, Soil types, Hydrogen ion concentration, Crop yield.

Sewage sludge containing high concentrations of potentially toxic elements such as zinc, nickel, cadmium and copper poses problems when deposed of on agricultural land. Added metals may accumulate and persist in soils and cause enhanced plant uptake many years after sludge application has ceased. The chemistry and bioavailability of added metals have been studied frequently, but over relatively short periods following sludge application; long term effects rarely been measured. Soils from three Danish experiments testing identical quantities of sewage sludge were sampled 5 years after the application of sludge ceased. Chemical studies on the soils involving single and sequential extractions, displaced solution measurements and plant uptake experiments in a glasshouse showed that sludge-added zinc, nickel, cadmium and copper persisted in extractable and bioavailable forms in the topsoils and that soil pH and texture influenced their chemistry and availability. 0.1 M calcium chloride is the best extractantant among those tried for predicting plant concentrations. There was no effect either of soil or of sludge treatment on the yield of barley plants. (Ray-PTT)
W88-03878

EFFECT OF SLAUGHTERHOUSE EFFLUENT AND WATER IRRIGATION UPON AGGREGATION IN SEASONALLY DRY NEW ZEALAND SOIL UNDER PASTURE,
New Zealand Soil Bureau, Lower Hutt.
G. J. Churchman, and K. R. Tate.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 4, p 505-16, 1986. 3 fig, 4 tab, 35 ref.

Descriptors: *Soil aggregates, *Slaughterhouse effluents, *Land disposal, *Irrigation, *Wastewater irrigation, *Clays, Scanning electron microscopy, Pastures, Organic matter, Effluents, Food-processing wastes.

The aggregation of soils is affected by organic matter, soluble ions and water, among other factors. Slaughterhouses play an extremely important part in New Zealand's economy. Much slaughterhouse effluent is disposed on pastures. Studies of the long-term (> 25 yr) treatment of a slit loam soil under pasture with slaughterhouse effluent showed that effluent did not affect macroaggregate stabilities as measured by wet-sieving, but increased the stability of clay aggregation as measured after selective disaggregation treatments. Highly humidified organic matter was associated with the soil clays as a result of slaughterhouse effluent treatment. Studies of the similarly long-term irrigation of the same soil type with water showed that water decreased the stabilities of macroaggregates as long as they were kept wet, but increased their stabilities after air-drying. Scanning electron microscopy showed a web that became firmly bound to soils only after drying. Stabilities of aggregated clays were largely unchanged by water irrigation, though their sensitivity to the removal of polysaccharides and organically bound cations was increased by this treatment. Changes in stabilities were not be related to earthworm numbers or to the extent of mycorrhizal infection. (Ray-PTT)
W88-03881

SUBSURFACE INJECTION OF LIQUID WASTE WITH EMPHASIS ON FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
J. J. Hickey, and J. Vecchioli.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2281, 1986. 25 p, 19 fig, 5 tab, 26 ref.

Descriptors: *Injection wells, *Underground waste disposal, *Florida, *Waste disposal.

Subsurface injection of liquid waste is used as a disposal method in many parts of the country. It is used particularly when other methods for managing liquid waste are either not possible or are too costly. Interest in subsurface injection as a waste-disposal method stems partly from a recognition that surface disposal of liquid waste may establish a potential for degrading freshwater resources. Where hydrogeologic conditions are suitable and where surface disposal may cause contamination, subsurface injection is considered an attractive alternative for waste disposal. Decisions to use subsurface injection need to be made with care because, where hydrogeologic conditions are not suitable for injection, the risk to water resources, particularly groundwater, could be great. The selection of subsurface injection as a waste-disposal method requires thoughtful deliberation and, in some instances, extensive data collection and analyses before a decision is finally made. Subsurface injection is an unusual method of waste disposal. As such, many state and local governmental officials and environmentally concerned citizens who make decisions about waste-disposal alternatives may know little about it. This report presents an elementary guide to subsurface injection and presents subsurface injection practices in Florida as an example of how one state is managing injection. (USGS)
W88-03900

POLLUTION POTENTIAL OF PIT QUARRIES EMPLOYED AS WASTE DISPOSAL SITES,
Missouri Univ.-Rolla. Dept. of Geophysics.
R. D. Rechstien, C. Woodbury, L. Awalt, and S. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183208/AS. Price codes: A03 in paper copy, A01 in microfiche. Final Technical Completion Report, Missouri Water Resources Research Center, Columbia. November 22, 1982. 22 p, 9 fig, 13 ref. Contract No. 14-34-0001-2127. Project No. OWRT A-136-MO.

Descriptors: *Path of pollutants, *Leachates, *Sanitary landfills, *Land disposal, *Quarries, Waste disposal, Leaching, Monitoring, Models, Model studies, Landfills, Pollutant identification, Missouri.

The use of abandoned pit quarries as waste disposal sites presents a problem of potential water pollution if leachate is carried through existing channels to areas far removed from the depositional site. A geophysical procedure based upon an electrical resistivity method was used to map small concentrations (volumes) that would represent leakage, or migration, of the leachate from the filled pit. The Dipole-dipole electrical resistivity field procedure was found suitable for monitoring leachate from the waste disposal site known as the Gray Clay mine. An inverse modeling procedure employing alpha centers was adopted to locate small pockets of highly conductive leachate. Although the alpha center inversion technique appears to be quite promising as a method of monitoring sanitary landfills for their pollution potential, considerable work is required to refine the method to a practical application method. (Geiger-PTT)
W88-03933

REUSE OF INDUSTRIAL FERMENTATION WASTEWATERS,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3C.
W88-03940

CHEMISTRY OF HEAVY METALS IN DIGESTED SEWAGE SLUDGE - I. COPPER (II) COMPLEXATION WITH SOLUBLE ORGANIC MATTER,
Oxford Univ. (England). Dept. of Agricultural Science.
For primary bibliographic entry see Field 5D.
W88-04017

CHEMISTRY OF HEAVY METALS IN DIGESTED SEWAGE SLUDGE - II. HEAVY METAL COMPLEXATION WITH SOLUBLE ORGANIC MATTER,
Oxford Univ. (England). Dept. of Agricultural Science.
For primary bibliographic entry see Field 5D.
W88-04018

AMMONIA VOLATILIZATION FROM LIQUID DIGESTED SEWAGE SLUDGE AS AFFECTED BY PLACEMENT IN SOIL,
Agricultural Research Service, Suffolk, VA. Tidewater Research and Continuing Education Center.
F. J. Adamsen, and B. R. Sabey.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 1080-1082, July-August 1987. 1 fig, 1 tab, 13 ref.

Descriptors: *Ammonia, *Volatilization, *Sludge, *Land application, *Wastewater disposal, Nitrification, Loam, Chemical analysis.

In a laboratory study, liquid sewage sludge was added to an Olney sandy loam (fine-loamy, mixed, mesic, Ustollic Haplargids) at a rate equivalent to 7.6 Mg/ha either on the surface or 25 mm below the surface. The sludge contained 11.2 g/kg NH4-N and 21.6 g/kg organic-N on a dry weight basis and 27 g/L solids. Surface applied sludge lost 40.3% of its NH4-N as NH3 in the first 2 weeks (95% of the total loss) while subsurface applied sludge lost 0.35% of added NH4-N as NH3 in the same period. Total NH3-N loss from surface applied liquid sludge was 36.0 kg/ha, which was 42.4% of added NH4-N. At the end of the study 96% of the inorganic-N was in the form of NO3 in sludge amended treatments. Fertilizer value of liquid sludge will be greater with subsurface injection than surface application. Where available N limits sludge loading rates surface application would reduce land requirements. (Author's abstract)
W88-04046

CONVERSION OF MUNICIPAL SLUDGE TO OIL,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-04071

BOSTON PROJECT TESTS METHODS AND MARKETS,
Massachusetts Water Resources Authority, Boston.
R. P. Trubiano, M. Thayer, S. J. Kruger, and F. Senske.
Biocycle BCYCDK, Vol. 28, No. 7, p 23-26, August 1987. 2 tab.

Descriptors: *Composting, *Massachusetts, *Sludge disposal, *Land disposal, *Recycling, *Sludge utilization, Dewatering, Soil amendments, Waste disposal, Landfills, Waste management.

The Massachusetts Water Resources Authority (MWRA) began operating a sludge composting

facility as a demonstration project in November 1984. The facility consists of 45,000 sq ft of paved area adjacent to the Deer Island wastewater treatment plant. Sludge processed by the composting facility is fed either by gravity, or pumped to a storage tank via a connection off the sludge discharge line to Boston Harbor. Sludge is mixed with bulking material by a front-end loader and placed on a one-foot bed of woodchips. Material is left in the processing piles for 21 days. After processing, the compost piles are broken down for curing and the woodchips are recovered on a mechanical deck screen. The Massachusetts Department of Environmental Quality Engineering (DEQE) determines the quality of the sludge for different uses. Several projects are being conducted to determine the applicability of MWRA compost for various end uses and its effect on the application site. A greenhouse study will analyze the agronomic suitability of the product for use in horticulture. Test distribution projects will be coordinated with DEQE to monitor the effects of the sludge on public land renovation and reclamation sites. The MWRA's Residuals Management Facility Plan calls for the development of mid-term privatization services for sludge processing and disposal from at least 1991 through 1995. The Authority's long-term sludge management option will be operational from 1995 to 2020. (Geiger-PTT)
W88-04087

TREATING WASTEWATER WITH HYACINTHS,
Austin Water and Wastewater Utility, TX.
For primary bibliographic entry see Field 5D.
W88-04088

SLUDGE PROVES EFFECTIVE AS FERTILIZER,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
J. A. Johnson, T. Gallagher, and L. M. Naylor.
Biocycle BCYCDK, Vol. 28, No. 7, p 33-35, August 1987. 6 tab, 3 ref.

Descriptors: *Sludge utilization, *Fertilizer, *Land disposal, *Deciduous trees, *Sludge disposal, Nitrogen, Heavy metals, Minerals, Nutrients, Biomass, Municipal wastes, Waste disposal, Waste management, Fertilization, Potassium, Recycling.

The use of dewatered sewage sludge was compared with commercial mineral fertilizer as a source of crop nutrients to enhance the growth of hybrid poplar trees. Dewatered sewage sludge was spread at rates of 11.2, 22.4, and 44.8 dry mg/ha on three strips of 0.24 ha each. Three similar strips received commercial fertilizer. In the spring of 1981, hybrid poplar cuttings were planted. In early September of 1982, leaf samples were collected from all of the clones in all of the treatments and analyzed for nutrient content and total metals. The foliar nutrient and mineral analysis showed no significant differences between treatments except in potassium. The sludge amended treatments were not significantly different from each other nor the control in the amount of foliar potassium, whereas three fertilzied plots had a significantly higher foliar potassium than the sludge or control plots. There was no significant difference in the metal concentration of the foliage between the sludge amended plots and the controls of fertilized plots. The total growth as measured from above-ground biomass accumulation in all of the sludge treatments was larger than that in any of the plots treated with commercial fertilizer. For this site, the use of municipal sewage sludge was found to be an effective fertilizer option for rapid production of woody biomass. (Geiger-PTT)
W88-04089

TALE OF TWO WASTES,
PPG Industries, Inc., Pittsburgh, PA.
S. W. Weber.
Biocycle BCYCDK, Vo. 28, No. 7, p 36-37, August 1987.

Descriptors: *Calcium carbonate, *Municipal wastes, *Sludge disposal, *Sludge utilization, *Land disposal, Waste management, Leachates, Landfills, Vegetation, Leaching, Limestone, Sodium compounds, Land reclamation, Water pollution prevention, Heavy metals, Recycling.

The Barberton Lime Lakes formed by the soda ash operations of Pittsburgh Plate Glass Company (now called PPG Industries) in the late 20th century represent an environmental wasteland devoid of vegetation and wildlife due to their high alkalinity. In 1982, PPG formed a task force of environmental scientists and engineers to look for ways to reclaim the lime lakes. A synthetic soil was formed by mixing sludge from municipal waste treatment with the lakes material. The task force has established base levels for groundwater contamination, collected data on leachates, researched ways to support plant growth on the lime lakes structures, and worked in developing specialized equipment to operate under all weather conditions on the lime lakes surface. Sludge is hauled to the operating area and spread at a controlled thickness on the surface of the lime waste. Several inches of material are excavated and mixed with the sludge. Grading is accomplished in stages by spreading sludge, mixing it into the waste, and moving and spreading the mixture to achieve the desired contour. More than a dozen species of plants, including grasses, legumes and various trees are in the third season of growth on the reclaimed areas. Natural grasses, flowers and weeds are invading the test areas as well as foxes, rabbits, mice and birds. The reclamation program has also reduced potential groundwater contamination. The lime lakes materials' high alkaline value fix the sludge's heavy metals, significantly reducing leaching into groundwater. The project has a permit running through 1988 to operate on a 36 acre test plot with full scale equipment. A permit is being sought to use this innovative technology on a long-term basis to reclaim all 600 acres of the lime lakes. (Geiger-PTT)
W88-04090

WHEAT HAY GROWN WITH SLUDGE,
Arizona Univ., Tucson. Coll. of Agriculture.
A. D. Day, R. K. Thompson, and R. S. Swingle.
Biocycle BCYCDK, Vol. 28, No. 7, p 40-41, August 1987. 3 tab.

Descriptors: *Sludge utilization, *Fertilizers, *Land disposal, *Sludge disposal, *Hay, Phosphorus, Potassium, Nitrogen, Nutrients, Wheat, Heavy metals, Minerals, Lead, Nickel, Cadmium, Zinc, Copper, Crop production.

An experiment at the Mesa (Arizona) Agricultural Center compared the effects of dried sewage sludge and inorganic fertilizers on the yield and quality of hay from Zaragoza wheat. Three fertilizer treatments were used: (1) recommended rates of N, P, and K for wheat in Arizona; (2) dried sewage sludge from the Phoenix Sewage Treatment Plant to supply N in amounts equal to the recommended rate; and (3) inorganic fertilizers to provide N, P, and K in amounts equal to those applied in the sewage sludge. The suggested fertilizer rate used for wheat was based on past cropping history and soil tests. Average number of days from planting to flowering and plant height were similar for all fertilizer treatments. Average lodging and hay yields for wheat fertilized with only sewage sludge and wheat fertilized with N, P, and K from commercial fertilizer in amounts equal to those in sewage sludge were similar and higher than the lodging and hay yields for wheat fertilized with suggested amounts of N, P, and K from commercial fertilizer. In vitro dry matter disappearance and total protein concentrations in wheat hay were similar in hay from all fertilizer treatments. Hay grown with sewage sludge and hay grown with N, P, and K from commercial fertilizer equal to the N, P, and K in sewage sludge contained more Pb and Ni than did hay produced with suggested N, P, and K from commercial fertilizer. These data suggest that a grower can produce high quality wheat hay for livestock feed using sewage sludge as a source of fertilizer and that the hay will not contain excessive amounts of Cd, Zn, Cu, Pb, and Ni. Concentrations of N, P, K, Na, and total soluble salts were higher in soil fertilized with dried sewage sludge for 10 years than they were in the original soil. (Geiger-PTT)
W88-04091

NUCLEAR REPOSITORIES IN NEW ENGLAND - A REGIONAL THREAT TO WATER RESOURCES,
New Hampshire Hazardous Waste, Water Supply and Pollution Control Commission, Concord.
M. A. Sills.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 209-215, June 1987. 5 fig, 1 tab, 2 ref.

Descriptors: *Radioactive waste disposal, *Site selection, *Evaluation, *Water pollution prevention, *Groundwater pollution, *Radioactive wastes, Groundwater, Water pollution, Water supply, New England, Domestic water, Aquifers, Bedrock, Public opinion.

In 1982 the Department of Energy (DOE) was directed to find two sites for nuclear waste repositories in the continental USA. The repositories were to be underground caverns located thousands of feet below the surface in salt beds, basalt, volcanic tuff or hard crystalline bedrock formations which would theoretically render the radioactive material harmless because contact with the environment would be theoretically impossible. However, the concept has not been verified in practice. The national screening of potential sites in crystalline rock for the second repository was completed in 1986 and the list included three sites in New England. Public outcry, and the results of a number of comprehensive state and local level studies caused the DOE to announce that the search for a crystalline repository was indefinitely suspended. Although socio-economic and political factors were associated with the decision, there was also a huge risk to New England water resources from such disposal techniques. Deep granite bedrock aquifers leak both horizontally and vertically to the surrounding surface waters, so location of radioactive material repositories in these areas will always represent a threat to regional water supply. The general area-wide constraints are explained, and the results of a comprehensive technical review of the site proposed in New Hampshire are detailed. Specific water resource limitations at the site include those related to surface water, groundwater, and public water supply. (Wood-PTT)
W88-04163

OCEAN'S ROLE IN A MULTI-MEDIA DISPOSAL ENVIRONMENT.
Water Pollution Control Federation, Alexandria, VA.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 927-931, November 1987.

Descriptors: *Ocean dumping, *Waste disposal, *Waste management, Regulations, Environmental effects, Recycling, Risk analysis, Laws.

The role of oceans in an overall waste management strategy is an issue of major concern. Some believe that there should be no ocean disposal of waste materials. Others believe that the ocean's enormous assimilative and regenerative capacities make it the disposal medium of choice. A balance must be struck between these two positions. That balance appears to lean toward a multimedia approach to waste management. The U.S. EPA has expressed the same sentiment in a policy statement in which it suggests that society should consider disposing waste where it is least costly to the environment and economy. However, EPA in the same document has concluded that it is not ready to make decisions on a cross-media, risk-balancing approach. At the moment and for at least the next few years, EPA does not have scientific data to make decisions confidently. It is the view of this committee that certain types of ocean disposal activities should be allowed. Sites should be carefully considered to reduce adverse environmental impacts. Greater public awareness is needed about the total risks associated with waste disposal through each medium, and concerted efforts to achieve waste reduction through reuse and recy-

cling. Federal laws and regulations need re-evaluating with a goal of reducing conflicts caused by medium-by-medium institutional structures. (Lantz-PTT)
W88-04193

L.A.'S WASTEWATER TREATMENT PLANT: VICTIM OR VILLAIN,
For primary bibliographic entry see Field 5D.
W88-04194

IMPROVED DESIGN AND OPERATIONAL PRACTICES FOR MUNICIPAL SLUDGE INCINERATORS,
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
W. G. Gilbert, F. L. Evans, H. Wall, F. X. Reardon, and E. M. Gowen.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 11, p 939-943, November 1987. 2 fig, 1 tab, 2 ref. EPA Contract No. 68-03-3208.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Sludge, *Sludge disposal, *Incineration, Design standards, Wastewater treatment facilities, Construction, Regulations, Wastewater treatment.

Multiple-hearth furnace (MHF) and fluid bed furnace (FBF) incineration systems for wastewater sludge are complex and require a high level of technical skill for successful operation. Under certain circumstances, the advantages of incineration as a sludge treatment option make the process a viable alternative for some municipal wastewater treatment facilities. Designers, owners, and operators of incineration systems should also be aware of possible future changes in air emissions requirements for sludge incinerators now being considered in Federal regulations development governing sludge disposal from municipal wastewater treatment facilities. Sludge incinerator performance can be improved by careful attention to equipment operation and management and process control. For example, recent EPA sponsored research demonstrates that improvements in incinerator operation can be achieved with expert analysis of the incineration process, equipment modifications, proper operation, and staff training. Operational incineration system models in three U.S. cities were studied and changes made. Upgrading work costs, including staff training, were normally recovered in fuel savings in a 3 to 6 month operating period. (Lantz-PTT)
W88-04195

INITIAL DILUTION OF HORIZONTAL JET IN CROSSFLOW,
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04269

HYDRAULICS OF SHALLOW AND STRATIFIED MIXING CHANNEL,
University of Western Ontario, London. Faculty of Engineering Science.
R. E. Baddour.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 630-645, May 1987. 14 fig, 1 tab, 18 ref, 2 append. Natural Sciences and Engineering Research Council of Canada Grant No. A1169.

Descriptors: *Outfall, *Dilution, *Dispersion, *Wastewater disposal, *Buoyant flow, *Stratified flow, *Mixing, *Channel flow, Hydraulic design, Flow profiles, Hydraulic properties.

The properties of buoyant and dense discharges in a horizontal mixing channel were evaluated analytically and experimentally. The mixing channel was shallow, of specified length and roughness, and connected to a reservoir or stream. The flow in the channel consisted of a mixing zone and a gradually varied counterflow. Mixing modes associated with four possible interactions are described. They are: Type A, drowned internal jump; Type B, free internal jump; Type C, upstream-controlled instability; and Type D, downstream-controlled instability. Minimum dilution is expected when the flow is of Types A or D, and maximum dilution when flow is at the transition between Type B and Type C. In a long or very rough channel, Types B or C may not be achievable under any discharge condition. The analytical model appears to be capable of predicting the essential features of the flow in a stratified mixing channel. (Lantz-PTT)
W88-04270

REUSE OF DOMESTIC WASTEWATER FOR IRRIGATION IN ARID ZONES: A CASE STUDY,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
For primary bibliographic entry see Field 3C.
W88-04277

REUSE OF MUNICIPAL WASTEWATER IN ARID COUNTRIES,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 3C.
W88-04353

IMPACT OF PULP AND PAPER MILL WASTEWATER ON CROP AND SOIL,
National Environmental Engineering Research Inst., Nagpur (India).
A. S. Juwarkar, and P.V.R. Subrahmanyam.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 693-700, 1987. 2 fig, 5 tab, 8 ref.

Descriptors: *Pulp wastes, *Pulp and paper industry, *Water pollution effects, *Water reuse, Impaired water use, Wastewater irrigation, Sodium, Crop yield, Chlorination, Water pretreatment, Soil quality.

Field and laboratory studies were carried out for 3 yr using pulp mill wastewater for crop irrigation. Anaerobically treated pulp mill wastewater used in the study falls under the class C3S1 to C4S2, and was found suitable for use on coarse textured soils with salt tolerant crops. Crops like maize, barley, wheat, kenaf and sesbenia were grown successfully. Wastewater irrigation increases the soil exchangeable sodium per cent (ESP). The increase in ESP at the end of the 3rd year was 30.0. However even at this level there was no appreciable decrease in the yield of crops and hydraulic properties of soil. Soil equilibrium studies showed that if the pulp mill wastewater is diluted with chlorination and hypochlorite wastewater in either 4:1 or 3:1 proportions, the resulting wastewater can be successfully used on coarse to medium textured soils without the problem of sodicity. (Author's abstract)
W88-04354

ASSESSMENT OF A LOW-COST WASTEWATER DISPOSAL SYSTEM AFTER TWENTY-FIVE YEARS OF OPERATION,
Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. L. Reidy, and G. W. Samson.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 701-710, 1987. 4 fig, 6 tab.

Descriptors: *Wastewater disposal, *Municipal wastewater, *Industrial wastewater, *Latrobe River Valley, *Australia, Wastewater irrigation, Environmental effects, Economic aspects, Performance evaluation, Costs, Soil quality.

A low-cost wastewater disposal system was commissioned in 1959 to treat domestic and industrial wastewaters generated in the Latrobe River valley in the province of Gippsland, within the State of Victoria, Australia. The Latrobe Valley is the center for large-scale generation of electricity and for the production of pulp and paper. In addition, other industries have utilized the brown coal resource of the region, e.g., gasification process and char production. Consequently, industrial wastewaters have been dominant in the disposal system for the past 25 years. The mixed industrial-domestic wastewaters were to be transported some 80 km to be treated and disposed of by irrigation to land. Several important lessons have been learned during 25 years of operating this system. First, the composition of the mixed waste stream has varied significantly with the passage of time and the development of the industrial base in the Valley, so that what was appropriate treatment in 1959 is not necessarily acceptable in 1985. Second, the magnitude of adverse environmental impacts engendered by this low-cost disposal procedure was not imagined when the proposal was implemented. As a consequence, clean-up procedures which could remedy the adverse effects of 25 years of impact are likely to be costly. The Latrobe Valley Water and Sewerage Board: (1) Initiated construction of an ocean outfall, essentially as proposed 25 years ago; (2) Required significant improvements in the quality and control of wastewaters discharged to the system; (3) Assessed the cost of rehabilitation of degraded soils. Approximately 1000 ha at a minimum cost of $2000/ha, i.e. $2,000,000; and (4) Assessed the possibility of rehabilitation of degraded wetlands having a volume of the order of 250,000 megaliters. (Lantz-PTT)
W88-04355

LOW COST CONTROLLED COMPOSTING OF REFUSE AND SEWAGE SLUDGE,
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-04368

REGIONAL SLUDGE TREATMENT AND DISPOSAL OPTIMIZING RELIABILITY AND COST,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5D.
W88-04369

EVALUATION OF HEAVY METAL LEACHABILITY FROM SOLID WASTES,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5B.
W88-04386

FLOW OF SURFACE BUOYANT JET IN CROSS FLOW,
Hydrological Research Unit, Wallingford (England).
For primary bibliographic entry see Field 5B.
W88-04390

PERFORMANCE EVALUATION OF SURFACE WATER TRANSPORT AND DISPERSION MODELS,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W88-04392

TWO-DIMENSIONAL BUOYANT JETS IN TWO-LAYER AMBIENT FLUID,
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-04394

INFLUENCE OF SURFACE WAVES ON OUTFALL DILUTION,
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
D. A. Chin.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 1006-1018, August 1987. 6 fig, 2 tab, 5 ref, append. Engineering Foundation Grant No. RI-A-85-4.

Descriptors: *Surface waters, *Waves, *Wastewater disposal, *Outfall, *Path of pollutants, Hydraulic properties, Mixing, Shallow waters, Mathematical analysis.

The influence of surface waves on the dilution of buoyant discharges is investigated. The relevant

dimensionless variables were derived. In the case of stagnant unstratified environments, the dilution depends on six dimensionless variables. An experimental program was conducted to determine the relationship between surface wave parameters and the dilution relative to the no-wave case. The dimensionless variables kept constant in the study were assigned values that are characteristic of operating ocean outfalls and are not wave-related. The results indicate that in shallow outfalls, in a typical persistent wave environment, the surface dilution is significantly higher than for the no-wave case. It was verified that, for an outfall in a depth of 7.7 m with persistent waves whose amplitude is 30 cm and whose period is 5 s, the surface dilution is twice that for the nowave case. This difference is quite important to the economics of shallow outfalls, especially with the gentle offshore slopes found in the southeastern United States. (Author's abstract)
W88-04395

SOCIO-ECONOMIC DEVELOPMENT LEVELS AND ADEQUATE TECHNOLOGICAL POLICY FOR WATER RESOURCES MANAGEMENT,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-04437

5F. Water Treatment and Quality Alteration

EVALUATION OF PACKED TOWERS FOR REMOVING VOLATILE ORGANICS FROM SURFACE WATERS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
J. W. Moore.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149332/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 124, June 1986. 20 p, 3 fig, 5 ref. Contract No. 14-08-0001-G1004. Project No. USGS G1004-04.

Descriptors: *Packed tower filtration, *Water treatment, *Trace organics, Aeration.

This study analyzes the potential of packed tower aeration as a remedial treatment process for the removal of trace organics from water on either an acute or chronic basis. Both pilot-scale and full-scale installations of the packed tower process were reviewed. Included are basic modeling considerations for the removal of volatile trace organics from raw water. Included also is an assessment of the state of the technology as applied to air stripping of water. (USGS)
W88-03503

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 2: ENVIRONMENT, HEALTH, AND RISK.
For primary bibliographic entry see Field 5C.
W88-03505

BIOFOULING ASSESSMENT AND CONTROL: AN ELECTRIC POWER RESEARCH INSTITUTE OVERVIEW,
Electric Power Research Inst., Palo Alto, CA.
W. Chow, and R. K. Kawaratani.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 887-900, 1 fig, 6 tab.

Descriptors: *Water treatment, *Fouling, *Powerplants, *Cooling water, *Chlorination, Invertebrates, Electric powerplants, Ozonation, Monitoring, Research priorities.

The Electric Power Research Institute is seeking to develop a systematic understanding of biofouling. Projects are underway or are being planned to develop data bases, explore chlorine reduction techniques and alternatives to chlorination, identify and develop biofouling detection and measurement techniques, and prepare design and operating guidelines. The ultimate goal of this research is a set of reference manuals that will integrate biofouling control with site selection, plant design, component selection, operation and maintenance procedures, instrumentation and control concepts, and regulatory and ecological concerns. (Author's abstract)
W88-03512

MECHANISM OF CHLORAMINE INACTIVATION OF POLIOVIRUS: A CONCERN FOR REGULATORS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, K. M. Tenno, and P. C. Loh.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1067-1076, 4 fig, 1 tab, 11 ref.

Descriptors: *Water treatment, *Disinfection, *Chlorination, *Viruses, Chloramine, Poliovirus, Regulations, Bromine compounds, Organic compounds.

The mechanism of poliovirus inactivation, which is similar for hypochlorous acid, chloramines, hypobromous acid, and bromamines, involves an effect on the protein coat of the virus to prevent the normal infectious cycle of poliovirus. However, because RNA could be extracted from poliovirus determined to be inactivated by these forms of halogens and demonstrated to be capable of replicating within cells, the general public may possibly be allowed to ingest halogen-inactivated virus and subsequently become infected as a result of successful release and penetration of the infectious RNA from the inactivated virus into the susceptible cells of man. No compelling evidence exists to show that these infectious viral nucleic acids do cause infections in humans, but no evidence denies this possibility. From a public health point of view, a disinfectant that destroys the nucleic acid of the genetic material of a virus is superior to a disinfectant that does not. The mechanism by which a disinfectant inactivates virus should be used as a criterion in comparing the relative effectiveness of disinfectants. Regulators who must select one disinfectant over another must be cognizant of this criterion. (Author's abstract)
W88-03525

REACTIVITY OF CHLORINE DIOXIDE WITH NUCLEIC ACIDS AND PROTEINS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Health Sciences.
C. I. Noxx, W. H. Dennis, and V. P. Olivieri.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1077-1086, 5 fig, 1 tab, 18 ref.

Descriptors: *Water treatment, *Chlorination, *Disinfection, *Chlorine dioxide, *Viruses, Proteins, Amino acids, Nucleotides, Cysteine, Tryptophan, Tyrosine, Proline, Histidine.

The effect of chlorine dioxide on biological compounds was studied with a model bacteria virus, f2. The following conclusions were reached: (1) The inactivation of f2 bacterial virus by 3 mg/L chlorine dioxide increases with increasing pH (5.0, 7.1, and 9.0). Of the four nucleotides in RNA, only GMP reacts with chlorine dioxide. Naked f2 RNA inactivation occurs more slowly than chlorine dioxide inactivation of intact virus. Five amino acids reduced chlorine dioxide by at least 10% within one hour. Cysteine, tryptophan, and tyrosine react rapidly with chlorine dioxide at acidic, neutral, and alkaline pH. Histidine and proline reactions with chlorine dioxide are too slow to be considered the primary site of inactivation. Consumption of chlorine dioxide by f2 capsid proteins is similar to consumption of chlorine dioxide by intact virus at acidic, neutral, and alkaline pH. The f2 proteins appear to be involved in chlorine dioxide reactions, resulting in rapid viral inactivation. (Cassar-PTT)
W88-03526

ENHANCEMENT OF CHLORINE INACTIVATION OF ESCHERICHIA COLI BY SODIUM IONS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and M. A. Zapkin.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1087-1096, 2 fig, 3 tab, 19 ref.

Descriptors: *Water treatment, *Chlorination, *Disinfection, *Bacteria, Coliforms, Sodium, Chlorine, Synergistic effects.

Sodium ions (0.1M sodium chloride or 0.1M sodium nitrate) can enhance the rate of inactivation of E. coli by free chlorine. The process kinetics are consistent with the extistence of an NaOCl ion pair of biocidal efficiency approximately equal to HOCl. Theoretical calculations indicate that, under proper circumstances, E. coli may exhibit greater sensitivity to free chlorine at high pH than at low pH. (Cassar-PTT)
W88-03527

CHLORINATION AS AN EFFECTIVE TREATMENT FOR CONTROLLING PATHOGENIC NAEGLERIA IN COOLING WATER OF AN ELECTRIC POWER PLANT,
Tennessee Univ., Knoxville. Dept. of Zoology and Entomology.
R. L. Tyndall, G. Kuhl, and J. Bechthold.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk. Ann Arbor Science, Ann Arbor, MI. 1983. p 1097-1103, 1 fig, 3 tab, 7 ref.

Descriptors: *Water treatment, *Disinfection, *Chlorination, *Cooling water, *Pathogens, Powerplants, Electric powerplants, Naegleria fowleri, Amoeba, Parasites.

Chlorine successfully controlled the pathogenic amoeba Naegleria fowleri in the cooling water system of an electric powerplant. Phase I chlorination of the cooling towers and adjacent canal on November 1, 1979, occurred over 5 hours operating in the open-cycle mode and resulted in 1.7-8.9 mg/L free residual chlorine (FRC) and 1.4-12.4 mg/L of total residual chlorine (TRC). Phase II, two weeks after Phase I, involved treatment of the entire cooling water system while operating in the closed-cycle mode. The 6-hour chlorination resulted in 2.3-10.6 mg/L FRC and 1.8-20 mg/L TRC. In both phases the desired 2 mg/L free chlorine level was reached. Two more chlorinations, similar to Phase II, were conducted in August 1980 and September 1981. Each chlorination reduced the pathogen levels 50- to 100-fold. However, the effect was not permanent, since organisms were isolated in some samples in spring and summer of 1980. (Cassar-PTT)
W88-03528

NOVEL BACTERICIDAL AGENT FOR TREATMENT OF WATER,
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, W. B. Wheatley, H. H. Kohl, H. D. Burkett, and J. H. Faison.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1105-1113, 2 fig, 1 tab, 10 ref. Project A-072-ALA.

Descriptors: *Water treatment, *Disinfection, *Chlorination, Chloramines, Agent I, 3-Chloro-4,4'-dimethyl-2-oxazolidinone, Toxicity, Chickens, Bacteria.

The chloramine agent 3-chloro-4,4'-dimethyl-2-oxazolidinone (Agent I) has been tested as a bactericide for the disinfection of water. It kills E. coli in water in a concentration range of about 5 mg/L, which is comparable to that used in standard chlorination in treatment plants. Other bacteria are also destroyed by Agent I, although generally requiring higher concentration levels. In a laboratory-scale water treatment plant Agent I produced bacteria-

free water when used in conjunction with a 15-ft sand filter. Preliminary toxicity data indicate that Agent I and its decomposition products are relatively nontoxic. A large group of broilers exposed to Agent I at the 200 mg/L level in their drinking water were not adversely affected over an 8-week period. Further testing on other animals and human subjects is warranted. Agent I is a stable solid and, as such, could not lead to catastrophic accidents in treatment plants or during public transportation. Furthermore, in water solution Agent I releases chlorine only on demand and thus remains stable in solution for extended periods. Chloramines do not tend to produce toxic haloforms in water as does chlorine gas. (Author's abstract)
W88-03529

CORRELATION OF WATER QUALITY PARAMETERS WITH MUTAGENICITY OF DRINKING WATER EXTRACTS,
Health and Welfare Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W88-03533

INFLUENCE OF OZONATION ON DIRECT-ACTING MUTAGENS FORMED DURING DRINKING WATER CHLORINATION,
Antwerpse Waterwerken (Belgium).
F. Van Hoof.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1211-1220, 7 fig, 2 tab, 8 ref.

Descriptors: *Water treatment, *Ozonation, *Chlorination, *Mutagens, *Organic compounds, Activated carbons, Adsorption, Fate of pollutants.

Ozone doses of 2 mg/L removed direct-acting frameshift mutagens formed by breakpoint chlorination of drinking water and adsorbed on XAD resins from neutral solutions. However, the direct-acting base-pair substitution mutagens recovered under the same conditions were not entirely removed by the 2 mg/L dose. Although higher ozone concentrations further decreased mutagenic activity, the decreases were not statistically significant. The decrease in mutagenic activity on bacteria strain TA100 corresponded to a decrease in levels of organic substances during ozonation. The best correlation was between mutagenic activity and ultraviolet absorbance. Ozone attacked the lower-molecular-weight fractions of the organic material adsorbing on the XAD resin from neutral solutions. The 2 mg/L dose of ozone produced hydrophilic direct-acting base-pair substitution mutagens. Granular activated carbon filters, fed with ozonated and unozonated influents, did not show any mutagenic activity when tested after 6 months of operation. (Cassar-PTT)
W88-03538

CONTAMINATION OF PURIFIED WATER BY MUTAGENIC ELECTROPHILES,
American Univ., Washington, DC. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-03539

DRINKING WATER PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. A. Cotruvo.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1417-1422, 1 tab, 6 ref.

Descriptors: *Regulations, *Water treatment, *Disinfection, *Chlorination, Water pollution effects, Public health, Risks, Trihalomethanes, Chlorinated hydrocarbons, Organic compounds, Drinking water, Chloramines, Chlorine dioxide, Water pollution sources, Groundwater pollution, Solvents, Research priorities.

The state of drinking water research and regulatory activities in the environmental impact and health effects of chlorination has been an active field in the last two years and will continue to be so. A great understanding of the technology and toxicology of chlorination processes has been gained, but much more work needs to be done and significant deadlines are approaching. The field of disinfection and oxidation has been expanding in the United States since 1975, when the First Water Chlorination Conference was held. Dealing technically with chlorination without seriously examining many other substances such as chlorine dioxide, ozone, bromine chloride, and chloramines is now difficult. (Author's abstract)
W88-03552

WATER CHLORINATION AND FOODS-FDA CONSIDERATIONS AND CONCERNS,
Food and Drug Administration, Rockville, MD.
G. L. Braude, and M. J. Wade.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1447-1455, 3 tab, 30 ref.

Descriptors: *Regulations, *Water treatment, *Chlorination, *Food processing industry, Toxicity, Water reuse, Wastewater irrigation, Risks, Drinking water, Bottled water, Food and Drug Administration.

The Food and Drug Administration has jurisdiction over additives used in food processing and in bottled water, whereas the Environmental Protection Agency controls drinking water quality. Regulations are described for use of chlorine and other chlorinated compounds in cooling water and washing water for food processing and for sanitizing water for surfaces in bottled water preparation. Water for reuse and recycling in food processing is often heavily chlorinated, raising the potential for contamination of the food by chlorine byproducts such as halomethanes. The risks of consuming chlorinated drinking water must consider the daily consumption, which averages 20% of total food intake. This is higher in individuals consuming large amounts of milk (infants), soft drinks or beef. Chlorination of wastewater or sewage before application to land and crops can also produce chlorinated substances which may be taken into the food crops. Reliable data on toxic chlorinated or oxidized reaction products are still insufficient, making it difficult to establish accurate tolerances or limits for use of chlorine in food processing and drinking water. (Cassar-PTT)
W88-03555

TEN YEAR SURVEY OF SALMONELLA AND ENTEROVIRUS IN RAW AND TREATED WATERS IN THE GREAT SAO PAULO AREA, BRAZIL,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
M. T. Martins, P. S. Sanchez, E. Marques, C. K. Monteiro, and A. G. Molina.
Water Science and TEchnology WSTED4, Vol. 18, No. 10, p 53-60, 1986. 1 fig, 5 tab, 24 ref.

Descriptors: *Wastewater treatment, *Salmonella, *Enteroviruses, *Public health, Microorganisms, Viruses, Aquatic bacteria, Bacteria.

A monitoring program was established in 1976 to detect Enterovirus and Salmonella in raw and treated waters from 9 water treatment plants in the Greater Sao Paulo area of Brazil. Salmonella was detected in 30.6% of 904 raw water samples but absent in 997 samples of treated water. Enteroviruses were detected in 14.9% of 383 raw water samples. From a total of 366 viruses isolated, 195 (53.3%) were Poliovirus, 79 (21.6%) were Echovirus, 30 (8.2%) were Coxsackievirus, and 62 (16.9%) isolates were untyped. Only 3 out of 975 treated water samples were positive for viruses (Poliovirus type 2, Coxsackie A16, and one untyped isolate); coliformes and Salmonella were not detected in these 3 samples, residual chlorine was present. In the sample where Poliovirus type 2 was present, free residual chlorine was 1.5 mg/liter and pH 9.2. The conventional water treatment procedures used were, in general, efficient for Enterovirus and Salmonella removal. (Authors' abstract)
W88-03565

BACTERIOLOGICAL ASPECTS OF RAIN-WATER HARNESSED FOR AN INSTITUTIONAL USE - A CASE STUDY,
Ife Univ. (Nigeria).
U. A. Adekunle.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 73-75, 1986. 1 tab, 8 ref.

Descriptors: *Rain, *Catchment basins, *Rainfall collection, *Cisterns, *Public health, Microorganisms, Bacteria, Pollutant identification, Coliforms, Enteric bacteria.

A high school with 1100 students at Ile-Ife, Nigeria, was used as a demonstration project for harnessing rainwater and storing it for use throughout the year. Bacteriological analyses of the underground stored rainwater and its piped distribution system were carried out at bi-monthly intervals during the rainy season and three time a month during the dry season. The rainwater catchments and underground storage reservoir were constructed during 1981-1982, and the collection of bacterial parameters initiated after the first rains to establish its pollution pattern. Aerobic heterotrophic bacteria, streptococci and coliforms were enumerated. Few coliforms were observed and no fecal coliforms were isolated. Rainwater harnessing should be practiced for domestic use, particularly in the tropical rain forest areas like southern Nigeria, to alleviate a shortage of water supply. (Author's abstract)
W88-03567

ENTERIC VIRUS REMOVAL FROM WATER BY COAL-BASED SORBENTS: DEVELOPMENT OF LOW-COST WATER FILTERS,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
M. Chaudhuri, and S. S. Sattar.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 77-82, 1986. 2 fig, 3 tab, 19 ref.

Descriptors: *Water treatment, *Enteric viruses, *Adsorption, *Filtration, *Activated carbon, *Filters, *Coal filters, Enteroviruses, Viruses, Public health.

Using poliovirus type I (Sabin) and dechlorinated tap water, several coal based sorbents were tested for their capacity to remove viruses from water. The sorbents included bituminous coal from Giridih, India, pretreated/impregnated with either alum, ferric hydroxide, lime or manganese dioxide. Commercially available active carbon, Filtrasorb-400, was used as a reference. In batch tests, with input virus concentration of 2.34-2.83 million PFU and sorbent concentration of 10g per 0.1 liter, alum pretreated coal removed about 96% of the virus at pH 6.3-8.9. Virus sorption was rapid and a plateau was reached in 30 min. Compared with the active carbon, alum pretreated coal exhibited greater sorption energy and about one log higher limiting poliovirus sorption capacity. Downflow column study indicated the potential of alum treated coal as a filter media for removing enteric viruses from water. A previous study showed this sorbent to be capable of removing enteric bacteria as well. Water filters prepared from such low-cost material may prove useful for domestic use in rural areas of India and other developing countries. (Authors' abstract)
W88-03568

OCCURRENCE OF ENTEROVIRUSES AND ROTAVIRUSES IN DRINKING WATER IN COLOMBIA,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
G. A. Toranzos, H. Hanssen, and C. P. Gerba.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 109-114, 1986. 2 tab, 10 ref.

Descriptors: *Water treatment, *Viruses, Enteroviruses, Rotaviruses, Pathogens, Microorganisms, Coliforms, Public health.

Relatively few studies have been conducted on the occurrence of enteric viruses in drinking water in developing countries. This study used positively charged microporous filters to detect enteric viruses in the drinking water of several major Colombian cities. Finished drinking water samples were collected at several drinking water plants whose treatment included flocculation, sand filtration and chlorination. Drinking water samples were also collected from the taps of private homes, hotels, and community taps. Viruses were concentrated by passage through positively charged filters. Adsorbed viruses were eluted with 10% tryptose phosphate broth adjusted to pH 9.5 and concentrated by ultracentrifugation before assay. Enteroviruses were detected by assay on BGM cells and rotavirus by assay on MA-104 cells. Three of 8 finished drinking water samples contained enteric viruses; rotaviruses in two and enterovirus in one. Two of the virus-containing samples also contained greater than 100 coliformes/100ml. Rotaviruses were isolated from 3 tapwater samples and enteroviruses from one. All of the tapwater samples which contained enteric viruses had visible turbidity and also contained coliform bacteria. (Authors' abstract)
W88-03571

DISINFECTION OF CHLORINE RESISTENT ENTEROVIRUSES IN GROUND WATER BY ULTRAVIOLET IRRADIATION,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5B.
W88-03572

COMPARATIVE DISINFECTION OF INDICATOR BACTERIA AND POLIOVIRUS BY CHLORINE DIOXIDE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5D.
W88-03573

SOME LIMITS IN CURRENT ADSORPTION-ELUTION METHODS FOR THE DETECTION OF VIRUSES IN LARGE VOLUMES OF TAP WATER,
Centre de Recherche de Maisons-Laffitte (France).
For primary bibliographic entry see Field 5A.
W88-03574

VIRUS ADSORPTION TO MICROPOROUS FILTERS MODIFIED BY IN SITU PRECIPITATION OF METALLIC SALTS,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W88-03575

INDICATOR SYSTEMS FOR ASSESSMENT OF THE VIROLOGICAL SAFETY OF TREATED DRINKING WATER,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W88-03577

EVALUATION OF BACTEROIDES FRAGILIS BACTERIOPHAGES AS INDICATORS OF THE VIROLOGICAL QUALITY OF WATER,
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W88-03578

MICROBIAL INDICATORS FOR THE EFFICIENCY OF DISINFECTION PROCESSES,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5A.
W88-03579

DRINKING WATER TRANSMISSION OF GIARDIASIS IN THE UNITED STATES,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W88-03584

HEALTH SIGNIFICANCE AND OCCURRENCE OF INJURED BACTERIA IN DRINKING WATER,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, M. W. LeChevallier, A. Singh, and J. S. Kippin.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 227-231, 1986. 17 ref.

Descriptors: *Drinking Water, *Bacteria, *Water pollution effects, *Fate of pollutants, Public health, Pathogenic bacteria, Pathogens, Human diseases, Diseases.

Enteropathogenic and indicator bacteria become injured in drinking water with exposure to sublethal levels of various biological, chemical and physical factors. One manifestation of this injury is the inability to grow and form colonies on selective media containing surfactants. The resulting underestimation of indicator bacteria can lead to a false estimation of water potability. A medium, m-T7, was developed specifically for the recovery of injured coliforms (both total and fecal) in drinking water. The m-T7 method was used to survey operating drinking water treatment and distribution systems for the presence of injured coliforms that were undetected with normal media. The mean recovery with m-Endo LES medium was less than 1 per 100 ml, but ranged from 6 to 68 per 100 ml with m-T7 agar. The majority of samples giving positive results with m-T7 medium yielded no detectable coliforms with m-Endo LES agar. Over 95% of the coliform bacteria in these samples were injured. Laboratory experiments demonstrated that injured enteropathogens, including Salmonella typhimurium, Yersinia enterocolitica and Shigella species required up to 20 times the chlorine levels to produce the same injury in enterotoxigenic Escherichia coli (ETEC) and nonpathogenic coliforms. Similar results were seen with Y. enterocolitica exposed to copper. The recovery of ETEC was followed by delayed enterotoxin production, both in vitro and in the gut of experimental animals. This indicates that injured waterborne enteropathogenic bacteria can be virulent. (Authors' abstract)
W88-03585

HIGH WATER DEMAND PRESSURE MONITORING,
C. Harrison.
Public Works PUWOAH, Vol. 118, No. 5, p 90-91, May 1987.

Descriptors: *Water distribution, *Systems analysis, *Water pressure, *Pressure distribution, *Testing procedures, *Pipelines, *Monitoring, *Water supply, *Water mains, Sewers, Gages, Gaging stations, Hydrants, Valves, Reservoirs.

An inexpensive way to test a water distribution system is to locate closed valves, verify design proposals, and give the system a general checkout. Peak demand pressure monitoring is a true performance test of a water distribution system. Pressure monitoring points should be near a point of known elevation; in a relatively flat area; and near the junction of two or more major water lines. Reference pressures are computed by subtracting the point elevation from the reservoir overflow level, and dividing by 2.308. This gives the static pressure at the given elevation. High demand pressure monitoring requires little time or special equipment, gives immediate results, and quickly locates trouble spots in the water system. (Main-PTT)
W88-03600

CARBON LEAVES GOOD TASTE IN CANADIANS' MOUTHS,
CH2M Hill Canada Ltd., Calgary (Alberta).
S. Lackey, and B. Park.
Water Engineering and Management WENMD2, Vol. 134, No. 4, p 21-23, April, 1987.

Descriptors: *Water quality, *Activated carbon, *Water treatment, *Water quality, *Chlorination, *Cyanophytes, *Carbon filters, *Potable water, *Algae, *Odor control, Carbon, Economic aspects, Dissolved solids, Clarification, Filtration, Regeneration, Reservoirs, Lakes, Ozonation, Eutrophication, Cropland.

CH2M Hill Engineering Ltd. received an Award of Excellence for their solution to the taste and odor problem stemming from the growth of blue-green algae in an artificial reservoir that provided the main water resource for two Saskatchewan cities. Water quality problems that arose from algal blooms included high total organic carbon, high chlorine demands, excessive trihalomethane formation, and large numbers of algae cells. As a solution a GAC-based (granular activated carbon) system was developed that met the following three major criteria: produced fresh tasting and smelling water; reduced organic content and trihalomethanes to acceptable levels; and was cost efficient. Eight carbon contactors were used to meet the plant's capacity of 32 mgd and constituted the final step in the water purification process following conventional clarification and filtration. GAC's ability to be regenerated provides cost savings sufficient to pay for the 3.5-dollar capital cost for the regeneration facilities in 3.5 years. The inaugural summer run met with uniformly good reviews from residents and visitors to the two cities. (Main-PTT)
W88-03601

WAVES IN THE WATER WORKS,
For primary bibliographic entry see Field 5G.
W88-03606

REDUCING WATER PUMPING POWER COSTS,
Waxahachie, TX.
T. Clark.
Southwest and Texas Water Works Journal STWJDV, Vol. 68, No. 12, p 4-5, March 1987. 4 fig.

Descriptors: *Water costs, *Economic aspects, *Water pumping, *Planning, *Electric power costs, *Wastewater treatment facilities, *Operating costs, *Utilities, *Water demand, Cost analysis, Efficiency, Water supply, Water storage, Tanks, Energy, Maintenance.

Electricity is the largest cost in the operating budget of water utility companies. An energy efficient pump and motor will pay for itself during its lifetime in energy savings. When operation procedures that work well during periods of heavy consumption are used during periods of low periods of consumption, overall system efficiency suffers. During low consumption periods this results in two to three times the pump starts. By minimizing pump starts, less electricity will be used and from a maintenance standpoint, this will increase motor life. By using the KWH per million gallons as an index, efficiency improves to an acceptable level. (Main-PTT)
W88-03612

PRACTICAL APPROACH TO WATER DISTRIBUTION SYSTEM MODELING,
Beta Engineering, Inc., Boston, MA.
H. Priola-Long.
Journal NEWWA JNEWA6, Vol. 101, No. 1, p 66-80, March 1987. 3 fig.

Descriptors: *Water distribution, *Model studies, *Computers, *Computer models, *Economic aspects, *Water delivery, *Water demand, *Project planning, *Long-term planning, *Optimum development plans, Engineering, Costs, Benefits.

The use of computers to solve water distribution system problems is discussed. Stages that must be followed to prepare a model and potential dangers of the modeling system are presented with case studies to show how models have been prepared and used in the field. The major benefits of having a water distribution system model are saving money and the development of long range system plans. A model of a distribution system can help

meet emergency problems and help set up an emergency action plan. (Main-PTT)
W88-03617

PRODUCTIVITY PROGRAM SAVES MILLIONS, BUT...,
Northern Telecom Electronics Ltd., Ottawa (Ontario).
B. Sheehy.
Public Works PUWOAH, Vol. 118, No. 4, p 40-41, April 1987.

Descriptors: *Training, *Productivity, *Canada, *City planning, *Personnel training *Civil engineering, Economic aspects, Water lines, Sewers, Water supply, Sanitation.

To rein in costs and improve supervisors' management skills, Calgary, Ontario invested more resources in employee training. Within the engineering department, pilot productivity programs were developed. Study groups and task forces in the water, sewer, streets, sanitation, and urban development departments produced a volume of innovative, workable improvement ideas. The pilot programs were so successful the concept was introduced on a city-wide basis. More time should have been spent preparing the culture in general, and middle management in particular for the program. As the program matures, training programs will extend to all employees rather than just those involved in study groups and task forces. (Main-PTT)
W88-03630

UPGRADED WATER SYSTEM PROMISES INDUSTRIAL GROWTH,
Stearns and Wheeler, Cazenovia, NY.
W. E. McFarland, and J. Florek.
Public Works PUWOAH, Vol. 118, No. 4, p 42-43, April 1987.

Descriptors: *Water supply, *Water demand, *Water storage, *Pipelines, *Fulton, New York, Groundwater, Water pumps, Minerals, Industrial development, Industrial water use, Water supply systems.

Fulton, New York contains several major industries that account for over 40% of the city's total water consumption. To meet demands and allow for future industrial growth, the city began a plan for an alternate source of supply, which was available from a transmission main carrying treated Lake Ontario water from Oswego. The use of this water would allow Fulton to supplement its groundwater supplies with purchased water to meet present and future demands. A grant from the U.S. Department of Commerce Economic Development Administration was provided to construct a new transmission main that would allow the use of the water from Lake Ontario and would also rehabilitate the existing waterworks facilities. Pumps, motors, electrical equipment, venture flow meters, and instrumentation were replaced, and the raw water storage tank and a standby tank were cleaned and refurbished. The new water source provides high quality water on demand and will allow for future development. (Main-PTT)
W88-03631

STUDY OF COPPER (II) COMPLEX COMPOUNDS WITH BISMUTHIOL DERIVATIVES IN BUTANONE,
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 5A.
W88-03638

RELATIONSHIP OF FLUORIDE IN DRINKING WATER TO OTHER DRINKING WATER PARAMETERS,
Iowa Univ., Oakdale. Dept. of Preventative Medicine and Environmental Health.
For primary bibliographic entry see Field 5C.
W88-03671

PLANNING OF RURAL WATER SUPPLY IN DEVELOPING COUNTRIES,
Qatar Univ., Doha.
S. Ahmad.
Aqua AQUAAA, No. 3, p 128-132, 1987. 5 fig, 1 tab, 12 ref.

Descriptors: *Water quality, *Water supply, *Planning, *Rural water supply, *Developing countries, *Water storage tanks, *Turbidity, Community participation.

Studies of raw water quality and protection of the sources, are vital in providing safe water to rural populations. Remoteness and access to rural areas in developing countries are constraints but these can be overcome by proper planning. Reduction of turbidity of a surface water source should be the main strategy in the first stage of the development of a rural water supply. Often the surface water source in semi arid zones is not perennial. Therefore, large storage tanks have to be provided for the period during which there is no water available in the source. Such tanks can function as extended sedimentation tanks, thereby removing the turbidity considerably, resulting in reduction of bacterial contamination to a great extent. Some persons from the village cluster should get involved during the construction of a water supply system so that they are familiar with the system and trained in its repair and maintenance. (Author's abstract)
W88-03677

USE OF PUBLIC RESOURCES FOR WATER SUPPLY AND SANITATION PROJECTS IN DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC.
J. Briscoe.
Aqua AQUAAA, No. 3, p 137-143, 1987. 8 tab, 55 ref.

Descriptors: *Cost benefits, *Water use, *Water demand, *Economic aspects, *Water, *Water conveyance, *Sanitation projects, *Developing countries, World Health Organization, Water distribution, Public policy.

The use of public sector funds for water supply and sanitation projects in developing countries is often justified primarily on the basis of the anticipated impact of these projects on health. At present there is no satisfactory basis for comparing investments in water supply and sanitation projects, which have multiple impacts, with other health programs, which have more limited impacts. A methodology for making these comparisons was developed on the basis of a resource allocation framework. The implications of the framework for the use of public funds and for the choice of level of service for water supply and sanitation programs in urban and rural areas are assessed. It is suggested that in many circumstances use of public resources is appropriate for partially funding water supply and basic sanitation services in densely populated rural and urban fringe areas. The major health impact is gained when basic sanitation facilities are provided; the additional health benefit from higher levels of service (e.t. water-borne sewerage in urban areas) is small and there appears little justification in committing public resources to these higher level of sanitation. (Ray-PTT)
W88-03679

WATER LOSSES IN MEDEN AND TEBING TINGGI, INDONESIA,
Water Supply Co. for the Province of North-Holland, Assen (Netherlands).
A. J. A. Kramer, W. F. J. Nooyen, and A. J. Vincent.
Aqua AQUAAA, No. 3, p 144-148, 1987. 5 fig, 3 tab, 2 ref.

Descriptors: *Water conveyance, *Metropolitan water management,*Water distribution, *Water loss, *Water meters, *Administrative water loss, Medan, Tebing Tinggi, Indonesia, Developing countries, Water, use, Water metering, Standpipes.

Pilot studies were undertaken in Meden and Tebing Tinggi on the Indonesian island of Sumatra, to assess the causes of water losses in the distribution systems of both cities. Unaccounted for ratios of 40% in Medan and 50% in Tebing Tinggi were measured. This study revealed that the greater part of the water losses was not caused by technical losses or leakage. In Medan water losses were mainly administrative losses. Nearly 50% of the water meters in the distribution system were out of order or unreliable. Therefore water consumption had to be estimated. In Tebing Tinggi losses were also mainly administrative as the public standpipes were not metered. Furthermore it was found that there was excessive water use and wastage at these standpipes. The problems met in Medan and Tebing Tinggi will probably be encountered in other developing countries. Thus to prevent water losses, more emphasis should be given to water meters, water meter readers and supply points. (Author's Abstract)
W88-03680

EXTENDED LOW FLOW PERFORMANCE - WHAT'S IT REALLY WORTH,
Rockwell International, Pittsburgh, PA.
R. N. Koch.
Aqua AQUAAA, No. 3, p 154-156, 1987. 2 fig, 3 ref.

Descriptors: *Water demand, *Water metering, *Water meters, *Water use Measuring instruments, Cost analysis.

Extended low flow performance refers to the accuracy of flow meters at or below 1/4 gal of water/min. Most water usage in the home takes place in the mid to high flow rates, between 2 and 11 gal/min. Two studies (one by the U.S. Department of Agriculture and the other by General Electric under contract to the American Society of Civil Engineers) which examined average, instantaneous water demand in typical residential settings confirmed that most water is used between 2 1/2 and 11 1/2 gal/min. Based on this information, it seems more important to have a metering device that delivers sustained, long-term accuracy at these typical flow rates rater than one which will measure accurately at flows of 1/2 or even 1/8 gal/min and begin to lose accuracy in 5 to 7 yr. As any meter begins to age, it becomes less accurate at both the low and high flow ends of the spectrum. At current water rates, extended low flow accuracy is only worth about 10 cents/yr/customer. However, sustained, long-term accuracy in the normal flow range is worth from $2 - $4/yr. The American Water Works Association's Water Meter Standard C-700 emphasizes that attention be given to the normal flow range of 2-10 gal/min which accurately captures the predominant use pattern found in both the USDA and GE studies. (Peters-PTT)
W88-03682

IMMUNOTOXICOLOGIC EVALUATION OF CHLORINE-BASED DRINKING WATER DISINFECTANTS SODIUM HYPOCHLORITE AND MONOCHLOROAMINE,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5C.
W88-03686

OBSERVATION OF DELIVERY AND SIMPLE QUALITY PARAMETERS ON SPRINGS OF THE FIRST VIENNA ELEVATED-SOURCE WATER SUPPLY,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
H. Frischherz.
Aqua AQUAAA, No. 4, p 175-180, 1987. 5 fig, 20 ref.

Descriptors: *Precipitation, *Water supply, *Water quality, *Springs, *Groundwater, *Water yield, Turbidity, Conductivity, Catchments, Hydrographs, Drinking water.

Yield, turbidity, conductivity and KMnO4 consumption were observed in springs of the First Vienna Elevated-source Water Supply and the results related to precipitation in the catchment. An increase in the retention of the precipitation has an equalizing effect on the yield and also on the

quality of the springs. Such an increase in retention can be achieved by afforestation and some other measures which lead to a reduction of the inglovw velocity of the precipitation water to the dolines. Control of the discharge of the springs leads to further retention of the water in the mountains. The use of karstic rock as a storage reservoir is possible only if the location of higher outcroppings of the source are known. It may be necessary to seal off such outlets. Then the karstic rock would be suitable for providing an annual storage reservoir that would allow for periods of low delivery during the early summer and frost periods in winter. By surveying water turbidity, it is possible to control karst springs so that highly turbid water originating from sudden heavy rains can be cut from the intake and discharged into an overflow. The sensitivity of karst springs to deposition of air pollutants during rain events was proven by their reaction after the Chernobly accident. Knowledge of the time it takes for air pollutants washed out by rain to be discharged from karst springs is necessary to ensure the safety of water from such Springs. (Peters-PTT)
W88-03761

RECENT DEVELOPMENTS IN DRINKING-WATER SUPPLY FROM THE INTERNATIONAL RIVERS RHINE AND MEUSE IN THE NETHERLANDS,
Biesbosch Water Storage Corp. (Netherlands).
E. G. H. Vreedenburgh, and J. M. J. Waals.
Aqua AQUAAA, No. 4, p 197-204, 1987. 11 fig, 3 tab, 12 ref.

Descriptors: *Water pollution control, *Water pollution treatment, *Water supply, *Rhine River, *River Meuse, *Drinking water, *Water quality, Water pollution sources, Model studies, Water resources, Decision making, Water storage.

The rivers Rhine and Meuse are the main sources for drinking-water production from surface water in the Netherlands. The hazards threatening these sources can be divided into three major topics. The first point concerns the still inadmissibly high day-to-day contamination with compounds like sodium chloride, xenobiotic substances and organic and inorganic micropollutants. The second major risk arises from the occurrence of exceptional situations like pollution incidents and periods of low river discharge. Possible future risks for these surface water sources constitutes the third major point of concern. Among these are the increasing number of nuclear power plants, the development and use of new chemicals and the far-reaching projected abstraction of surface water for different purposes from the river Meuse. As the possibilities for the Dutch drinking-water companies to urge protection and sanitation of Rhine and Meuse are very limited, it is important for a reliable water supply to enhance the knowledge of these sources and to improve the source characteristics by means of open or closed storage systems. The enhancement of the knowledge includes studies of the river-flow and emissions, measurements of the actual water quality, modelling of the rivers, both in stationary and in exceptional situations, and perfecting the alarm systems. The improvement of the source characteristics by storage systems is illustrated by the Biesbosch storage reservoirs in which water supply can be ensured during periods of low river flow or poor water quality. The storage also greatly improves the water quality by self-purification processes and a selective intake policy. Computer applications are helpful for the optimization of the intake and storage. Recently simulation models have been developed, that simulate the source characteristics, intake and storage system and increase the insight in these stages and the interactions between them. Expert-systems can be developed as another tool to manage the increasing knowledge, data and the complexity in decision making. (Author's abstract)
W88-03764

KINETICS OF ADSORPTION ON ACTIVATED CARBON: I. SINGLE-SOLUTE SYSTEMS,
Norges Tekniske Hoegskole, Trondheim.
J. Fettig, and H. Sontheimer.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 764-779, August 1987. 5 fig, 6 tab, 39 ref. Deutsche Forschungsgemeinschaft SFB 62, Project A 34.

Descriptors: *Water chemistry, *Water treatment, *Adsorption, *Kinetics, *Activated carbon, Solutes, Drinking water, Mass transport, Surface area.

Adsorption kinetics of a variety of single substances on activated carbon was investigated at low liquid-phase concentrations. Experimental data obtained by the minicolumn method show the influence of dissociation and molecular weight of the adsorbates on their external mass transfer behavior. Modeling of minicolumn breakthrough curves proves that internal mass transport resistances have to be taken into account at low concentrations as well as high. A differential fixed-bed reactor technique was used to determine intraparticle mass transport parameters. For strongly adsorbable substances, diffusion in the adsorbed phase proves to be prevailing, whereas for weakly adsorbable or high molecular weight adsorbates, pore diffusion also contributes to the internal mass transport. However, the surface diffusivities depend on the carbon loading in an adsorbate-specific manner. (See also W88-03796 and W88-03797) (Author's abstract)
W88-03795

KINETICS OF ADSORPTION ON ACTIVATED CARBON: II. MULTISOLUTE SYSTEMS,
Norges Tekniske Hoegskole, Trondheim.
J. Fettig, and H. Sontheimer.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 780-794, August 1987. 7 fig, 4 tab, 21 ref, append. Deutsche Forschungsgemeinschaft SFB 62, Project A 34.

Descriptors: *Model studies, *Water chemistry, *Water treatment, *Adsorption, *Kinetics, *Activated carbon, Solutes, Drinking water, Diffusion.

Most models that have been developed to described multicomponent adsorption are based on the assumption that different absorbates interact with regard to equilibrium only. This approach is examined at low adsorbate concentrations. Multicomponent data obtained by the minicolumn method prove that the external mass transfer of one substance is not affected by the simultaneous diffusion of other adsorbates. Bisolute adsorption rate experiments conducted in a batch system show two different impacts of multicomponent adsorption on the intraparticle mass transport. The surface diffusion of the more weakly adsorbed substance can be accelerated when both species are adsorbed simultaneously. On the other hand, surface diffusion of both adsorbates is hindered when displacement processes take place. The experimental results are also used to investigate procedures for lumping individual substances into pseudocomponents with regard to kinetic parameters. (See also W88-03795 and W88-03797) (Author's abstract)
W88-03796

KINETICS OF ADSORPTION ON ACTIVATED CARBON: III. NATURAL ORGANIC MATERIAL,
Norges Tekniske Hoegskole, Trondheim.
J. Fettig, and H. Sontheimer.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 795-810, August 1987. 7 fig, 4 tab, 33 ref.

Descriptors: *Fulvic acids, *Model studies, Water chemistry, *Water treatment, *Adsorption, *Kinetics, *Activated carbon, Solutes, Drinking water, Prediction, Estimating, Diffusion.

Adsorption kinetics of a fulvic acid (FA) were investigated in detail. Based on experimental equilibrium data, the mixture was subdivided into two pseudocomponents with different adsorbabilities and one nonadsorbable fraction. Thus the impact of the initial concentration on the overall isotherm could be described well. However, equilibrium data of the FA after preadsorption were poorly predicted. Minicolumn experiments allowed for the determination of external mass transfer coefficients of the adsorbable pseudocomponents. The results also yielded an estimation of the effective diffusivity and the average molecular size of the FA in the bulk liquid phase. Intraparticle diffusivities were evaluated from batch kinetic experiments. The overall concentration change with time was well described by the film-homogeneous diffusion model, while the behavior of the pseudocomponents could be described more closely by the film-heterogeneous diffusion model. The applicability of the models to predict a minicolumn breakthrough curve is discussed. (See also W88-03795 and W88-03796) (Author's abstract)
W88-03797

THEORY OF DECLINING RATE FILTRATION. I: CONTINUOUS OPERATION,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
F. H. Chaudhry.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 834-851, August 1987. 6 fig, 27 ref, append.

Descriptors: *Model studies, *Declining rate filtration, *Water treatment, *Filters, *Filtration, *Sand filters, Equations, Head loss, Flow.

A theoretical framework for the study of variations in rate, head loss, and concentration during declining rate filtration (DRF) is developed. A simple model for the variable rate filtration is derived in order to formulate the continuous declining rate response of a sand filter in terms of a first-order non-linear ordinary differential equation for the dimensionless filtrate volume. This formulation indicates that there are four dimensionless parameters that determine the behavior of a declining rate filter. The differential equation is solved numerically by the Runge-Kutta method to obtain a single filter response as a function of time. The importance of various parameters is discussed for the true DRF and influent flow-splitting arrangements. The theoretical framework developed here permits modeling the behavior of a filter bank in terms of oscillations in head loss, rate, and concentration in the DRF mode, which is presented in a subsequent paper. (See also W88-03801) (Author's abstract)
W88-03800

THEORY OF DECLINING RATE FILTRATION. II: BANK OPERATION,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
F. H. Chaudhry.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 852-867, August 1987. 9 fig, 1 tab, 19 ref, append.

Descriptors: *Bank filters, *Model studies, *Declining rate filtration, *Filters, *Water treatment, *Filtration, *Sand filters, Equations, Head loss, Water quality.

In declining rate filtration (DRF), the mode of operation of a bank of filters modifies and determines the performance of an individual rapid sand filter. The theoretical formulation previously developed by the writer for continuous DRF is extended to the case of bank-operated DRF. The problem is expressed as a system of first-order nonlinear differential equations for the dimensionless filtrate volumes produced by various filters in the bank. Variable DRF mode of operation is considered explicity in this formulation. The theoretical model permits a study of the evolution of water equality, head loss, and filtration rate of each filter in the bank. (See also W88-03800) (Author's abstract)
W88-03801

BIOLOGICAL DENITRIFICATION OF DRINKING WATER USING AUTOTROPHIC ORGANISMS WITH H2 IN A FLUIDIZED-BED BIOFILM REACTOR,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).

M. Kurt, I. J. Dunn, and J. R. Bourne.
Biotechnology and Bioengineering BIBAU, Vol. 29, No. 4, p 493-501, March 1987. 20 fig, 2 tab, 8 ref.

Descriptors: *Denitrification, *Drinking water, *Water treatment, *Biological treatment, *Biofilm reactors, *Fludized-bed, *Autotrophic organisms, *Bacteria, Nitrates, Nitrites, Nitrogen removal.

Many sources of drinking water, especially in areas of intensive agriculture contain high levels of nitrate ion. One possible process technology to removal nitrate ions is biological denitrification as practiced in wastewater treatment. In this technique a carbon source, such as ethanol or acetone is added to water. In drinking water systems, however, addition of similar chemicals is not acceptable. It is therefore of interest to seek a denitrification process that does not require addition of a carbon source. In this study an autotrophic organism capable of reducing nitrate ion and oxidizing hydrogen gas to water was used to denitrify drinking water. This organism is also capable of utilizing carbon dioxide present in water as a source of carbon. The objective of this study was to investigate the application of a small-scale fluidized sand bed reactor and to establish reactor kinetics. No appreciable diffusion of the organism employed as a biofilm was found. Reactor performance was a function of the culture's past history. Batch experiments always exhibited an accumulation of nitrite ion, but continuous experiments with residence times of 4.5 hr showed complete removal of nitrogen with waters containing up to 25 mg of nitrate N/L or approximately 1 hr for every 5 mg/L. (Ray-PTT)
W88-03817

LEGIONNAIRES' DISEASE OUTBREAKS - THE ENGINEERING IMPLICATIONS,
For primary bibliographic entry see Field 5B.
W88-03821

PCB CONTAMINATION OF A PRIVATE WATER SUPPLY,
For primary bibliographic entry see Field 5B.
W88-03836

IDENTIFICATION OF TRACE ORGANIC CONTAMINANTS IN INORGANIC WATER TREATMENT CHEMICALS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 5A.
W88-03838

WATER TREATMENT PLANT OPERATION REVIEW MANUAL FOR OPERATORS,
Michigan Dept. of Public Health, Lansing. Section of Water Supply.
W. E. Brown, and R. S. Sacks.
Volume 1. Ann Arbor Science, Ann Arbor, MI. 1981. Edited by V. W. Langworthy. 182 p.

Descriptors: *Water treatment, *Pollutant identification, *Water analysis, Training, Bacterial analysis, Ccliforms, Sampling, Sample preparation, Plankton, Nannoplankton, Zooplankton, Algae, Sedgwick-Rafter method, Reservoir management, Coagulation, Alum, Hardness, Alkalinity, Water softening, Disinfection, Chlorination, Residual chlorine, Filtration, Flow rate, Flow measurement, Hydraulics, Pumps.

A manual reviews the basics of water treatment plant operation. Operators can use it to study for certification examinations, and supervisors can use it for training and testing utility personnel. Bacteriology discusses the theory and laboratory procedures for the total coliform membrane filter method and the total coliform multiple-tube fermentation method. Biologic examination topics include sample collection and examination (membrane filter procedures, drop and coverglass mounts, Sedgwick-Rafter cells, nannoplankton slides), plankton identification, counting procedures records and forms, significance and application of results. Basic chemistry pertinent to water treatment covers coagulation, alum chemistry, total hardness, alkalinity, softening chemicals, split treatment, and stability. Chlorine reactions and methods for determining chlorine residuals appear in the disinfection chapter. Types of filters, filtration mechanisms, filter bottoms, filter backwashing, and flow rate controls are subtopics under filtration. Hydraulics is divided into pressure calculations, flow equations, and flow measurement. Operations and treatment procedures, including chemical overfeed problems, are discussed, as well as pump types, efficiency, and costs. Sample and practice problems with answers are provided. (Cassar-PTT)
W88-03981

DICTIONARY OF WASTE AND WATER TREATMENT,
National Coal Board, London (England).
For primary bibliographic entry see Field 5D.
W88-03982

LEGIONELLA PNEUMOPHILA IN A HOSPITAL WATER SYSTEM FOLLOWING A NOSOCOMIAL OUTBREAK: PREVALENCE, MONOCLONAL ANTIBODY SUBGROUPING AND EFFECT OF CONTROL MEASURES,
University Hospital of Wales, Cardiff. Public Health Lab.
C. D. Riberio, S. H. Burge, S. R. Palmer, J. O. Tobin, and I. D. Watkins.
Epidemiology and Infection, Vol. 98, No. 3, p 253-262, June 1987. 5 tab, 13 ref.

Descriptors: *Human diseases, *Legionella pneumophila, *Water supply, *Water quality control, *Hospitals, Public health, Monitoring, Water quality, Legionnaires Disease, Disinfection, Microbiological studies.

Swabs and water samples from a hospital water system were cultured for legionellae over an extended period. Legionella pneumophila serogroup 1, including outbreak associated strains, were isolated in small numbers from approximately 5% of these samples despite implementation of the current DHSS/Welsh Office regulations. No cases of nosocomial legionaires disease were proven during the study. Physical cleaning and chemical sterilization of taps, and replacement of washers with 'approved' brands did not eradicate the organisms. Eradication of legionellae in hospital water supplies appears to be unnecessary in preventing nosocomial legionnaires' disease provided the current DHSS/Welsh Office recommendations are implemented. (Author's abstract)
W88-03994

BACTERIOLOGY OF THE FRESHWATER ENVIRONMENT: IMPLICATIONS FOR CLINICAL THERAPY,
Vanderbilt Univ., Nashville, TN. School of Medicine.
For primary bibliographic entry see Field 5B.
W88-03997

COMBINED EFFECT OF CARBON DOSAGE AND INITIAL ADSORBATE CONCENTRATION ON THE ADSORPTION ISOTHERM OF HEAVY METALS ON ACTIVATED CARBON,
National Univ. of Singapore. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-04020

DETERMINANTS OF THE MICROBIOLOGICAL CHARACTERISTICS OF SPA POOLS IN SOUTH AUSTRALIA,
South Australian Health Commission, Adelaide.
For primary bibliographic entry see Field 5B.
W88-04026

IODOFORM TASTE COMPLAINTS IN CHLORAMINATION,
Western Australia Dept. of Mines, Perth. Government Chemical Labs.
R. C. Hansson, M. J. Henderson, P. Jack, and R. D. Taylor.
Water Research WATRAG, Vol. 21, No. 10, p 1265-1271, October 1987. 9 fig, 2 tab, 11 ref.

Descriptors: *Iodoform, *Taste, *Chloramination, *Drinking water, *Water treatment, *Water quality, Ammonia, Chlorine, Bromine, Iodine, Chlorination.

Iodoform (CHI3) plus four of six possible iodo derivatives, CHClBrI, CHBr2I, CHClI2 and CHBrI2 have been found in chloraminated drinking water. The presence of iodoform in concentrations > 5 micrograms/L was associated with an objectionable medicinal taste in the water. Production of iodoform was dependant on the order of addition of the chlorine and ammonia. When ammonia was added first, the water samples had the characteristic medicinal taste. Disappearance of the taste in plant-treated samples stored for >2 wk was accompanied by a decrease in iodoform concentrations to values below the taste threshold. When chlorine was added first, there was no medicinal taste and iodoform levels were <1 microgram/l; levels of bromoform and chloro-bromomethanes were increased. (Lantz-PTT)
W88-04030

BIODEGRADABILITY OF OZONATION PRODUCTS AS A FUNCTION OF COD AND DOC ELIMINATION BY EXAMPLE OF SUBSTITUTED AROMATIC SUBSTANCES,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. Wassertechnologie.
For primary bibliographic entry see Field 5D.
W88-04031

HEALTH SERVICES AND WATER AND SANITATION SERVICES IN THE NORTHWEST TERRITORIES: AN EXAMINATION OF THE PRESENT STATE OF DEVELOPMENT AND SOME THOUGHTS FOR THE FUTURE,
Izaak Walton Killam Hospital for Children, Halifax (Nova Scotia).
L. McIntyre, and G. Heinke.
Canadian Journal of Public Health CJPEA4, Vol. 78, No. 4, p 244-248, July-August, 1987. 3 fig, 1 tab, 14 ref.

Descriptors: *Public health, *Water treatment, *Legislation, *Wastewater treatment, *Rural areas, *Canada, *Sanitation, Water pollution effects, Epidemiology, Water policy, Water supply, Water law, Morbidity, Human diseases, Regulations.

The state of health services and water and sanitation services in the Northwest Territories (NWT) are examined. The distances between rural communities in the NWT presents a problem to public water suppliers. Cold climates and frozen soils prohibit the use of groundwater supplies. Other problems in providing a sanitary water supply are the lack of technical personnel, the lack of a service base in most communities, and the lack of knowledge and experience of how to develop servicing technology appropriate to northern regions. To overcome these problems regulations under the Public Health Ordinance establish the planning, design and operation requirements of all water and sanitation facilities necessary to achieve and safeguard public health. The Northern Inland Waters Act, which is directed to the preservation of environmental quality of inland rivers, lakes and coastal waters, regulates the withdrawal of water and the discharge of wastewater by issuing permits that affect the building of water and sanitation facilities. The Water and Sanitation Policy of 1962 establishes acceptable levels of water and sanitation service as applied to the wide variation in development in the 60 NWT communities. Outbreaks of low mortality sanitation-related diseases are mostly related to a low availability of water for use in personal hygiene rather than contamination of the water supply. Most homes in the NWT lack complete indoor plumbing and water delivery is by truck to storage tanks in homes. The Indian Health Policy adopted by the federal government in 1979 is promoting the capacity of NWT communities to play an active, more positive role in the health care system. (Geiger-PTT)

W88-04077

BACTERIAL QUALITY OF BOTTLED WATER,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W88-04122

MODEL CHLORINATION OF PLANT DERIVED PHENOLIC WATER CONTAMINANTS WITH AN ASSESSMENT OF THEIR POTENTIAL TOXICITY TO ESCHERICHIA COLI,
Reading Univ. (England). Dept. of Physiology and Biochemistry.
For primary bibliographic entry see Field 5C.
W88-04146

MODIFICATIONS TO ROCKVILLE WATER TREATMENT PLANT,
Connecticut Water Co., Clinton.
K. W. Kells, and R. W. Muther.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 104-117, June 1987. 5 fig, 1 tab.

Descriptors: *Water treatment facilities, *Water treatment, Treatment facility modification, *Connecticut Water Company, Design criteria, Treatment capacity, Water quality standards, Water quality, Water quality management, Costs, Lake Shenipsit, Drinking water.

The Connecticut Water Company's Rockville Water Treatment Plant, which was put into operation in May 1970, was designed to treat 5 million gallons of Lake Shenipsit water per day by chemical addition, flocculation, clarification and filtration followed by post-chlorination and fluoridation of the water as it entered the distribution system. The plant's capacity became restricted to about 3 mgd over the following ten years as a number of structural and operational problems developed and water quality standards became more stringent. Therefore, the plant and its equipment were inspected, the Federal and State requirements for quality of treated water were reviewed, and methods for improving the treatment process and for increasing the plant capacity were investigated. The original plant, the problems needing correction, the design of the modifications, and the methods of accomplishing the necessary changes are detailed. The facility is equipped to handle the requirements placed on it today as a result of the implemented modifications at a total cost of approximately 3,000,000 dollars. (Wood-PTT)
W88-04158

CONNECTICUT'S WATER SUPPLY PLANS,
Connecticut Dept. of Health Services, Hartford. Water Supply Section.
R. Jarema.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 118-144, June 1987.

Descriptors: *Water supply plans, *Water supply, *Planning, *Water demand, *Connecticut, Water supply plans, Water allocation, Water conveyance, Drought, Water resources development, Water law, Water shortage, Alternative planning.

As a result of the drought of 1980-81, during which several Connecticut utility companies experienced severe water shortages, a Water Resources Task Force was established to investigate water supply issues. The Task Force developed and fostered the passage of an act that requires all utilities serving more than 1000 people to submit a water supply plan. A water supply plan should evaluate the water supply needs of its service area and propose a strategy to meet those needs. Plans should include, but not be limited to: (1) a description of the existing water supply system; (2) an analysis of future supply demands; (3) an assessment of alternative water supply sources; (4) contingency procedures for public drinking water supply emergencies including emergencies concerning water contamination, water supply system failures, and water shortages; and (5) a recommendation for new water system development. A copy of the Proposed Regulations of the Department of Health Services Water Supply Plans is included. (Wood-PTT)
W88-04159

WATER DISTRIBUTION RECORD KEEPING AND PLANNING APPROACHES: CURRENT UTILITY PRACTICES,
Peer Systems, Inc., Philadelphia, PA.
D. K. O'Day.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 145-168, June 1987. 4 fig, 7 tab.

Descriptors: *Water mains, *Planning, *Record keeping, *Water conveyance, *Water distribution, Long-term planning, Comparison studies, Failure analysis, Pipes, Water transport, Conveyance structures, Water loss, Leakage, Pipelines, Maintenance.

The record keeping practices, water main failure patterns, and planning approaches are analyzed and compared for six water utilities in order to provide information on break trends and rates with respect to pipe material, joint type diameter, soil conditions, corrosion conditions, external loading, construction practices and season of the year so that individual utility companies can compare its experiences with a representative cross section of utilities and make long-term plans. To ensure consistency between utilities, a standard set of definitions was developed so that the data set treats leaks, main breaks, and appurtenance breaks consistently. Main repair rates were expressed in number of repairs per 100 miles per year to provide a direct comparison between utilities. Although water main break and repair patterns varied widely among the utilities studied, similarities emerged. A case study is presented showing how distribution system repair reports, annual condition reports and leak repair incident maps monitor water distribution system conditions and assist in replacement and repair decisions. (Wood-PTT)
W88-04160

AIR STRIPPING TREATMENT FOR REMOVAL OF VOLATILE ORGANIC CHEMICALS: A CASE STUDY OF BURLINGTON, MASSACHUSETTS,
Metcalf and Eddy, Inc., Wakefield, MA.
R. N. Jarnis, J. F. Shawcross, and S. L. Bishop.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 169-196, June 1987. 3 fig, 9 tab.

Descriptors: *Water treatment, *Air stripping treatment, *Water quality control, *Volatile organic chemicals, *Groundwater pollution, Groundwater management, Water pollution control, Organic compounds, Aquifers, Massachusetts, Monitoring, Pollutants, Water pollution, Costs, Economic aspects.

Because of the confirmation of the presence of high concentrations of volatile organic chemicals (VOCs) in the Vine Brook Aquifer in Massachusetts, an extensive program was undertaken to investigate the problem and take remedial action. The groundwater contaminant monitoring program showed that: (1) severe VOC contamination exists throughout the Vine Brook Aquifer with contaminants found in all 8 production wells and all 28 monitoring wells; (2) although some sampling wells exhibited a decreasing level of contamination, unacceptable levels are expected to persist for considerable time; and (3) contamination severely limits the town of Burlington's ability to provide adequate water supply so water from 3 of the closed wells must be rehabilitated by treatment. A treated water requirement of total VOCs of less than 1 microgram/liter was established to ensure that the quality of the finished water from the Phase I treatment facility would exceed current quality requirements and meet the more stringent ones expected in the future. Results of the pilot study were presented and used to size and design the air stripping process which was used to remove VOCs from the water. A breakdown of the construction cost of 905,000 dollars is presented and operating and maintenance costs are estimated. Although the Groundwater Treatment Plant was not yet completed, the air stripping towers were operated at design conditions for two 6-hour periods to allow for sampling and VOC removal performance testing; preliminary approval was granted to operate the facility since the effectiveness of the rehabilitation by air stripping was demonstrated. (Wood-PTT)
W88-04161

WHAT'S HAPPENING WITH WATER: INDUSTRY DIRECTION - LOOKING TO THE FUTURE,
Becher-Hoppe Engineers, Inc., Wausau, WI.
A. E. Becher.
Journal of the New England Water Works Association JNEWA6, Vol. 101, No. 2, p 197-208, June 1987.

Descriptors: *Water treatment, *Water distribution, *Water management, *Water quality control, *Regulations, Water quality, Water quality management, Water research, Water rates, Economic aspects, Public opinion, Public relations, Management planning.

A summary of the challenges facing the water utility industry in the 1980's and 1990's, as identified in the American Water Works Association's Strategic Plan, is presented. While these challenges, including water quality, research, small systems, water rates, and public education, each present their own set of special problems, they also have the common characteristic of being industry-wide challenges that will not be resolved by the independent action of an individual utility. Reviews of the history of the water industry, imposed standards, relevant legislation, restrictions in water pricing, and public opinion are given. (Wood-PTT)
W88-04162

DICHLORAMINE DECOMPOSITION IN THE PRESENCE OF EXCESS AMMONIA,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
C. T. Jafvert, and R. L. Valentine.
Water Research WATRAG, Vol. 21, No. 8, p 967-973, August 1987. 9 fig, 1 tab, 19 ref.

Descriptors: *Disinfection, *Water treatment, *Decomposition, *Dichloramine, *Ammonia, Hydrogen ion concentration, Phosphates, Chemical reactions, Kinetics, Monochloramine, Dichloramine.

The decomposition of aqueous dichloramine in the presence of excess ammonia was studied to verify a proposed decomposition mechanism. Experiments were conducted under conditions in which the three significant reactions were isolated from others that could potentially complicate interpretation of results. The decomposition of dichloramine, producing primarily nitrogen gas and monochloramine, was initiated by mixing solutions of dichloramine and monochloramine under varying experimental conditions of pH, phosphate concentration, and initial dichloramine and monochloramine concentration. The chloramine concentrations were then monitored titrimetrically with time. Rate constants characterizing the reactions were determined using nonlinear least squares regression analysis and the reaction stoichiometry determined by comparing dichloramine loss to monochloramine formed. Phosphate did not catalyze the decomposition which suggests that the mechanism does not involve general base catalysis. A mechanism including a direct reaction of monochloramine was indicated based on both kinetic and stoichiometric considerations. The experimental results obtained at a high initial ratio of dichloramine to monochloramine could be reasonably predicted with the proposed mechanism and one set of rate constants. However, the constants were somewhat dependent on the initial dichloramine ratio. This discrepancy may be due to the existence of another reaction(s) not included in the proposed mechanism. (Author's abstract)
W88-04260

STABILITIES OF NEW N-HALAMINE WATER DISINFECTANTS,
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, D. E. Williams, and S. B. Barnela.
Water Research WATRAG, Vol. 21, No. 8, p 983-988, August 1987. 9 fig, 1 tab, 19 ref. Army Medical Research and Development Command Contract No. DAMD 17-82-C-2257.

Descriptors: *Disinfection, *Water treatment, *N-Halamine, Organic compounds, Bromine, Chlorines, Chemical stability.

The stabilities in water of several new N-halamine disinfectants have been measured. Variables in the study included pH, temperature, and water quality (demand-free and synthetic-demand). An inverse relationship exists between the stabilities of the compounds and their efficacies against Staphylococcus aureus. The most stable compounds of those studied, 1,3-dichloro-4,4,5,5,-tetramethyl-2-imidazolidinone (A) and 3-chloro-4,4-dimethyl-2-oxazolidinone (I), are possible candidates as water disinfectants for high-temperature applications such as hot tubs and cooling towers. While the N-bromamines studied were generally less stable but more biocidal than their chloramine analogs, the mixed bromochloro compound 1-bromo-3-chloro-4,4,5,5-tetramethyl-2-imidazolidinone (ABC) provided rapid initial disinfection due to the Br moiety and slower long-term disinfection due to the Cl moiety. The disinfectant of choice is dependent upon the application. (Author's abstract)
W88-04262

NITRATE REMOVAL FROM GROUND WATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
J. P. Van der Hoek, and A. Klapwijk.
Water Research WATRAG, Vol. 21, No. 8, p 989-997, August 1987. 12 fig, 6 tab, 40 ref.

Descriptors: *Nitrates, *Groundwater quality, *Water treatment, Ion exchange, Denitrification, Brines, Sulfates, Resins.

A new technique for nitrate removal from groundwater is a combination of ion exchange and biological denitrification. Nitrate is removed by ion exchange. Regeneration of the resin in a closed circuit is achieved with a denitrification reactor. In contrast with traditional denitrification procedures there is no direct contact between groundwater and denitrifying bacteria. Also brine production and regeneration salt requirements are minimal compared to conventional regeneration of ion exchange resins. The basic design criteria are presented. The first pilot plant results show that the process is very attractive when compared with ion exchange and biological denitrification as separate techniques. Groundwater with a relatively high sulfate concentration can be treated when a nitrate selective resin is used. (Author's abstract)
W88-04263

BISCAYNE AQUIFER CONTAMINATION: CLEANUP AND PREVENTION,
CH2M Hill, Emeryville, CA.
For primary bibliographic entry see Field 5G.
W88-04291

ECONOMIC EFFICIENCY AND INVESTMENT TIMING FOR DUAL WATER SYSTEMS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6B.
W88-04300

WATER TREATMENT RELATED CHARACTERIZATION OF THE PHOTOCHEMICAL DEGRADATION PRODUCTS OF AQUATIC HUMIC SUBSTANCES (AUFBEREITUNGSORIENTIERTE ASPEKTE DES PHOTOCHEMISCHEN ABBAUS AQUATISCHER HUMINSTOFFE),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
H. Bauer, and F. H. Frimmel.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 118-122, August 1987. 9 fig, 14 ref. Deutsche Forschungsgemeinschaft Fr 536/8.

Descriptors: *Pollutant identification, *Water treatment, *Humic acids, *Ultraviolet radiation, *Chemical reactions, *Drinking water, Wastewater treatment, Chlorinated hydrocarbons, Degradation, Irradiation, Adsorption, Flucculation.

The growing interest in UV-irradiation in water treatment requires a detailed investigation of the photochemical reactions of water constituents. Humic substances deserve special attention. In an irradiation apparatus (reactor with liquid circulation, low pressure Hg-lamp) samples at an initial concentration of 9.6 mg/l dissolved organic carbon (DOC) were irradiated up to three hours. The spectral absorbances at lambda = 436 nm (yellow color) and lambda = 254 nm decreased with irradiation time more rapidly than the DOC. Increasing adsorption on activated carbon and decreasing elimination by Fe(III) flocculation was obtained. The absolute values of the chloroform formation potential (CBP) decreased with increasing irradiation time, whereas the specific values remained constant. Treatment related parameters are of practical importance for the characterization of humic substances which cannot be described by exact molecular structures. (Author's abstract)
W88-04341

EFFECT OF OZONATION ON THE IMPAIRMENT OF FLOCCULATION BY ALGOGENIC ORGANIC MATTER,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
O. Hoyer, H. Bernhardt, and B. Luesse.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 123-131, August 1987. German Bundesministerium fuer Forschung und Technologie grant No. 02-WT-035/372.

Descriptors: *Ozonation, *Flocculation, *Literature review, *Water treatment, Surface waters, Drinking water, Oxidation, Chemical reactions, Humic acids, Optimization, Alginic acid, Ozone, Carboxylic acid.

Applications and effects of ozonation on flocculation and filtration processes for drinking water production are discussed, along with a literature review. Up until now, publications have dealt predominantly with ozonation effects related to humic matter, while from practical observations algogenic organic matter (EOM) has also been found to be of relevance, at least in the case of surface waters. Several kinds of EOM, known to be typical in their flocculation-interfering properties, were ozonized in an apparatus corresponding to practical conditions. Supplies of ozone in the range 0-8 mg O3/mg C resulted in the consumption of 0-2 mg C. In all cases consumption of > 1 mg O3/mg C gave rise to increased flocculation impairment. Lower O3 consumptions were found to lead to a reduction of impairment, but in one case the already low O3 doses increased flocculation impairment directly. From changes in the polymer acidities of the EOM by ozonation and their change in effects on flocculation, reaction mechanisms are discussed and confirmed by experiments with alginic acid as a model compound. The findings exclude an oxidative formation of carboxylic groups on the macromolecules of the mainly polysaccharidic EOM. It seems, however, that in a first step, ozone leads to a degradation to monomers, but without formation of acidic carboxylic groups. In a second step the monomers are further oxidized into carboxylic acids which are known to cause significant impairment of flocculation. (Author's abstract)
W88-04342

PRELIMINARY INVESTIGATION INTO THE IMPROVEMENT OF THE BIODEGRADABILITY OF ORGANIC SUBSTANCES IN SURFACE WATERS AND EFFLUENTS THROUGH OZONATION,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W88-04377

INVESTIGATION OF THE PERFORMANCE OF TWO NEWLY INSTALLED DEFLUORIDATION PLANTS IN SOUTH AFRICA AND SOME FACTORS AFFECTING THEIR PERFORMANCE,
National Inst. for Water Research, Pretoria (South Africa).
J. J. Schoeman, and G. W. Leach.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 953-965, 1987. 10 fig, 7 tab, 10 ref.

Descriptors: *Defluoridation, *South Africa, *Water treatment, Alumina, Suspended solids, Metals, Scouring, Water treatment, Costs, Chemical treatment, Fluorides.

Two activated alumina defluoridation plants have recently been installed and commissioned at a mine in South Africa. A reduction in plant capacity was experienced as a result of fouling of the activated alumina by entrapped suspended solids, metal hydroxides, carbonates and adsorbed silicates. It was demonstrated, however, that plant capacity could be restored by using backwashing and air scouring with rinsing repeatedly, using acid treatment periodically for silicate and hardness removal, and by performing an interrupted run. Plant performance would also have been improved by the use of smaller sized (0.5 to 1.0 mm) alumina particles. Chemical costs for fluoride removal should vary between 15 and 18 c/cu m. Periodic cleaning of the fouled alumina, for example every fifth cycle, would add 2 c/cu m to production costs. (Author's abstract)
W88-04379

RELIABILITY-BASED OPTIMIZATION MODEL FOR WATER DISTRIBUTION SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
Y. C. Su, L. W. Mays, N. Duan, and K. E. Lansey.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 12, p 1539-1556, December 1987. 4 fig, 9 tab, 21 ref. NSF Grant No. ECE-8511399.

Descriptors: *Model studies, *Water distribution, Costs, Economic aspects, Water supply, Optimization, Pipes, Water conveyances, Simulation analysis, Mathematical models, Mathematical studies.

The basic framework for a model that can be used to determine the optimal (least-cost) design of a water distribution system subject to continuity conservation of energy, nodal head bounds, and reliability constraints is presented. Reliability is defined as the probability of satisfying nodal demands and pressure heads for various possible pipe failures (breaks) in the water distribution system. The overall model includes three that are linked: a steady-state simulation model, a reliability model, and an optimization model. The simulation model is used to solve implicitly the continuity and energy constraints and is used in the reliability model to define minimum cut sets. The reliability model, which is based on a minimum cut-set method, determines the values of system and nodal reliability. The optimization model is based on a generalized reduced-gradient method. Two examples are used to illustrate the model: (1) a hypothetical one-loop 14-pipe network; and (2) three pipes were added to the example 1 system to give a 17-pipe, four-loop system. (Lantz-PTT)
W88-04410

STRENGTH OF ALUMINIUM HYDROXIDE FLOCS,
British Aerospace Aircraft Group, Kingston upon Thames (England).
R. J. Francois.
Water Research WATRAG, Vol. 21, No. 9, p 1023-1030, September, 1987. 7 tab, 4 fig, 36 ref.

Descriptors: *Aluminum hydroxide, *Flocculation, *Chemical coagulation, *Water treatment, *Wastewater treatment, Turbulent flow, Chemical

treatment, Theoretical analysis, Equilibrium, Aggregates, Separation techniques, Coagulation, Erosion, Eddy diffusion, Flow velocity.

Flocculation processes used in water and wastewater treatment are usually carried out under turbulent regimes. For the interpretation of the energy spectrum of such a turbulent hydrodynamic regime, Kolmogoroff's universal equilibrium range theory is generally accepted. Factors affecting floc strength are summarized for different break-up mechanisms, namely fragmentation of flocs and erosion of primary particles from the surface. Determinations of floc strength were made using different velocity gradients (G-values) and other varied parameters. Results showed that floc dimensions do not depend on the average velocity gradient in the flocculator, but on the local velocity gradient of the impeller-affected zone. Completely built flocs will resist rupture by a velocity gradient better than flocs formed under identical conditions, but after that they are already broken by lower velocity gradients. Flocs with dimensions of the order of magnitude of the turbulence scale for inertial convection will be ruptured to large fragments. Those subjected to viscous forces will be ruptured by the erosion of small particles from the floc surface. Erosion and fragmentation occur simultaneously. The pH does not have any significant influence on the strength coefficient. The recovery ability of flocs and their resistance to rupture improve with an increase of the quantity of suspended solids and an increase of the G-value of the slow mixing step. (Geiger-PTT)
W88-04441

ADSORPTION OF HEAVY METALS ONTO HYDROUS ACTIVATED CARBON,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-04442

ION EXCHANGE FOR THE REMOVAL OF HUMIC ACIDS IN WATER TREATMENT,
Reinertsen (A.R.) Consulting Engineers, Trondheim (Norway).
H. Brattebo, H. Odegaard, and O. Halle.
Water Research WATRAG, Vol. 21, No. 9, p 1045-1052, September, 1987. 7 fig, 4 ref, 9 ref.

Descriptors: *Ion exchange, *Humic acids, *Water treatment, *Scandinavia, *Models, *Adsorption, Optimization, Separation techniques, Organic compounds, Resins, Sorption, Organic matter, Costs, Color.

The removal of humic substances is today one of the more important objects in Scandinavian water purification technology. The conventional process is coagulation/flocculation/separation. During the last few years local pilot scale experiences on the ion exchange process were obtained using a macroporous strong base resin. The process removes humic acids effectively, particularly at moderate humic acid concentrations in the water to be treated. The inlet concentration and the bed contact time were of course found to be the most important parameters. In order to minimize the operating costs, special attention has to be paid to regenerate routines and an optimum process design. By the use of a beds-in-series system and reuse of the regenerant, the chemical consumption may be cut; waste solution production then is also cut by a factor of 10.35, in relation to the use of one single fixed-bed without regenerant reuse. The waste production for such a system was found to be 1 cu m when treating 5910 cu m water with color 50 milligrams Pt/l. The process is very well suited for automation and continuous effluent quality control, however, more attention should be given to corrosion problems. (Author's abstract)
W88-04443

NEW APPROACH TO THE PREDICTION OF FLUIDIZATION OF FILTER MEDIA,
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
Y. Muslu.
Water Research WATRAG, Vol. 21, No. 9, p 1053-1060, September, 1987. 5 fig, 3 tab, 15 ref.

Descriptors: *Filter medicine, *Filtration, *Model studies, *Water treatment, *Fluidized bed process, *Mathematical models, Fluidized beds, Reynolds number, Mathematical studies, Filters, Saturated flow, Porosity, Density, Particle shape.

The application of a mathematical model developed for flow through granular beds and for predicting fluidization and expansion of filters is presented. An assemblage of spheres having a rhombic arrangement with spacing between the particle centers adjusted according to the observed porosity, is used as a model to investigate the physics of saturated flow. Using this model an equation is derived to express the minimum fluidization rate as a function of sphericity, density and porosity. Application of a new model for predicting the expansion of filter media is also presented. (Author's abstract)
W88-04444

PREDICTING OPTIMUM BACKWASH RATES AND EXPANSION OF MULTI-MEDIA FILTERS,
Sheffield City Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-04447

OZONATION OF PURINES IN AQUEOUS SOLUTION: KINETIC STUDIES OF THE REACTION, (OZONATION DES BASES PURIQUES EN MILIEU AQUEUX: ETUDES CINETIQUES DE LA REACTION),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, P. Nompex, and M. Dore.
Water Research WATRAG, Vol. 21, No. 9, p 1101-1107, September, 1987. 6 fig, 5 tab, 17 ref.

Descriptors: *Ozonation, *Purines, *Ozone, Kinetics, Oxidation, Water treatment, Disinfection, Chemical reactions.

The direct reaction of ozone on adenine, guanine and purine in aqueous solutions, and the value of activation energy of purine ozonation was studied in volumetric flasks. A two order kinetic law was found for each compound. Ozonation consumes 4 mol O3/mol of purine. The reaction order concerning purine was degenerated to accelerate the reaction rate. The value of activation energy, 15.3 kcal/mol, was similar to that mentioned in previous studies (1983) for ozonation of organic compounds. Adenine reacts very rapidly with ozone, so the reactions had to occur at 2 degrees. The stoichiometry was 2 mol O3/mol of adenine. The stoichiometry of the reaction with guanine was difficult to determine but thought to be 1 mol O3/mol of guanine. (Geiger-PTT)
W88-04449

THIOSULFATE-DECHLORINATION INTERFERENCE WITH THE FOLIN-CIOCALTEU REAGENT METHOD FOR PROTEIN DETERMINATION,
Johns Hopkins Univ., Baltimore, MD. Div. of Environmental Health Engineering.
J. G. Jacangelo, V. P. Olivieri, and K. Kawata.
Water Research WATRAG, Vol. 21, No. 9, p 1143-1144, September, 1987. 2 fig, 7 ref.

Descriptors: *Water treatment, *Proteins, *Chlorine, *Sulfur compounds, *Chemical analysis, Disinfection, *Pollutant identification, Chlorination, Water analysis, Reagents.

Sodium thiosulfate is employed routinely for dechlorination of water and wastewater disinfection. A study was conducted to evaluate interference with the Lowry method using the Folin-Ciocalteu reagent for protein determination by the dechlorination products of chlorine or monochloramine. Free chlorine, monochloramine or sodium thiosulfate alone did not cause color formation with the test. However, when the disinfectants were dechlorinated with thiosulfate, the reaction products yielded false positives for protein. These false positives were detected at disinfectant concentrations as low as 0.3 milligrams/liter as available chlorine. (Author's abstract)
W88-04454

5G. Water Quality Control

MISSISSIPPI WATER RESOURCES CONFERENCE, 1986.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-03493

EVALUATION OF THE SANITARY QUALITY OF MARINE RECREATIONAL WATERS AND SANDS FROM BEACHES OF THE SAO PAULO STATE, BRAZIL,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
For primary bibliographic entry see Field 5A.
W88-03566

WAVES IN THE WATER WORKS,
M. Adessa.
Civil Engineering CEWRA9, Vol. 57, No. 3, p 48-50, March 1987.

Descriptors: *Ohio River, *Cincinnati, *Environmental policy, *Potable water, *Regulations, *Water quality, *Carbon filtration, *Legislation, *Water treatment, *Water supply, *Legal aspects, *Safe Drinking Water Act, Technology, Economic aspects, Pollutants, Chemical wastes, Organic compounds, Hazardous materials, Carcinogens, Standards.

The 1986 Amendments to the 1974 Safe Drinking Water Act are stringent laws with heavy penalties to force compliance with safe drinking water levels. But the cost to small utilities will be considerable, and safe levels may not be safe. Congress passed the 1986 Amendments because of intense public concern, heavy environmental lobbying and because of dismay over EPA's sluggish pace to set safe contamination levels following the passage of the Safe Drinking Water Act. The EPA set two contamination levels–one based on health the other on technology. From the health standpoint, the maximum contaminant level goal, represents the level at which a contaminant has no anticipated health effect, along with a margin of safety. Technically, granular activated carbon is considered the best available technology for removing organic contaminants. To determine what safe drinking water is, the EPA looked for every chemical known to be, or possibly be, in drinking water. To determine the effects of these chemicals, EPA does risk analyses. The difference between the health premise and the technological premise opens up numerous situations to litigation. If a state isn't enforcing federal standards, citizens can bring a utility to court and ask the court to enforce installment of a system that meets federal standards. Despite its broad demands, legal questions, and scientific uncertainty, the amendments are a fist step toward controlling the contaminants in our water. (Main-PTT)
W88-03606

UNDERGROUND STORAGE TANKS POTENTIAL FOR ECONOMIC DISASTER,
Law Environmental Services, Marietta, GA.
For primary bibliographic entry see Field 5B.
W88-03610

LEGAL THEORIES AND DAMAGES EMPLOYED IN GROUNDWATER POLLUTION LITIGATION,
Day, Berry and Howard, Hartford, CT.
For primary bibliographic entry see Field 6E.
W88-03613

PREPARATION AND TRIAL OF A GROUNDWATER CONTAMINATION CASE,
Day, Berry and Howard, Hartford, CT.

A. Zakarian.
Journal NEWWA JNEWA6, Vol. 101, No. 1, p 22-31, March 1987.

Descriptors: *Groundwater pollution, *Legal aspects, *Economic aspects, *Environmental protection, *Liability, *Drinking water, *Water quality, Environmental quality, Water pollution effects, Legislation, Public policy, Laws, Chemistry, Pollutants, Water use.

Comments on how to investigate, prepare and try a groundwater pollution case are provided. Topics included are: outlining the elements of proof; assembling a team of experts; developing a testing program so you are able to predict the flow of groundwater and the contaminant; and developing a trial theme and strategy. There is a real threat of ruinous contamination of our groundwater supplies by polluters. When suing those who have contaminated water supplies, operators of water companies should take an aggressive posture, emphasizing to a judge and jury that polluters not the victims should bear the costs of cleaning up contamination. (Main-PTT)
W88-03614

UTILIZING CABLE TV TO YOUR PR ADVANTAGE,
Wannacomet Water Co., Nantucket, MA.
For primary bibliographic entry see Field 6G.
W88-03616

VIRAL ANTIBODIES IN AGRICULTURAL POPULATIONS EXPOSED TO AEROSOLS FORM WASTEWATER IRRIGATION DURING A VIRAL DISEASE OUTBREAK,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5B.
W88-03672

PEOPLE WHO GET IN THE WAY: CHANGING VALUES IN URBAN WASTE MANAGEMENT,
York Univ. (England). Inst. of Social and Economic Research.
For primary bibliographic entry see Field 5D.
W88-03717

RECENT DEVELOPMENTS IN DRINKING-WATER SUPPLY FROM THE INTERNATIONAL RIVERS RHINE AND MEUSE IN THE NETHERLANDS,
Biesbosch Water Storage Corp. (Netherlands).
For primary bibliographic entry see Field 5F.
W88-03764

MODELLING SEA-WATER INTRUSION IN THE ATLANTIS AQUIFER,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
For primary bibliographic entry see Field 2F.
W88-03772

INFLUENCE OF TEMPERATURE ON OXYGEN TRANSFER,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W88-03793

COMPLEX SEWERAGE JOB MOVING,
C. Pinyan.
Engineering News Record ENREAU, Vol. 218, No. 6, p 22-23, February 1987.

Descriptors: *Tunnel construction, *Combined sewers, *Milwaukee, *Water pollution prevention, *Urban runoff, *Tunnels, *Soil mechanics, Storm-overflow sewers, Sewer systems.

The water pollution abatement program (a $1.8 billion project) at Milwaukee, Wisconsin, passed its halfway mark in January 1987. The project is designed to prevent 50 combined-sewer overflows, mostly caused by storm water, into three Milwaukee rivers and Lake Michigan. This will be achieved by constructing 62 miles of new sewers and interceptors. To handle a runoff area of 26 square miles the system will consist of 19 miles of deep tunnels to store flows until two treatment plants can process them. The project also includes expansion of two waste treatment plants: one from 200 to 300 mgd and the other from 100 to 250 mgd. In tunnel construction, some of which are as large as 32 ft in diameter, the most difficult part was to reach the solid bedrock layer, especially in the lower river valley area. In this region the bedrock is 150 to 190 ft below the surface and the soil consists of a mixture of silty clay, sand and boulders. The best way to sink the major shafts was ground freezing. Of the total cost of the project, one-third will be paid by EPA grants and another one-third by state grants. (Ray-PTT)
W88-03814

PROCESS PLANTS AS HAZARDOUS-WASTE FACILITIES,
Jacobs Engineering Group, Inc., Baton Rouge, La.
M. Bradford.
Chemical Engineering CHEEA3, Vol. 94, No. 3, p 69-71, March 1987. 3 fig, 3 ref.

Descriptors: *Chemical industry, *Hazardous materials, *Storage tanks, *Groundwater pollution, *Water pollution prevention, *Spill detection, *Dikes, *Sumps, Incineration.

Chemical plants handling hazardous materials are potential sources of soil and groundwater contamination. To prevent potential leakage from reaching the soil special care is needed in designing tank foundations, diked areas and sumps. The key to foundation design is to provide adequate means to detect leaks rather to try to contain them. The diked area around the tanks should be sloped toward a sump designed to catch spills and to keep rainwater from building up in the diked area. Sumps are like underground tanks in that a leak cannot be detected easily. Hence special maintenance procedures, for example, periodic pumping out of liquids should be carried out. The other alternative is to fit the sumps with some type of double liner and provide with extra supports of steel and concrete. Other precautionary measures, such as, providing those working in the contaminated area with proper EPA recommended safety devices and installing of nonsparking blowers and proper grounding of pipings in ventilation hoods should be undertaken. Vented gases should preferably be incinerated but absorption on activated carbon is also acceptable. Flare is an acceptable alternative to incineration only for occasional use and back up to the incineration. (Ray-PTT)
W88-03816

STATISTICAL ANALYSIS OF INDUSTRIAL WASTEWATER MONITORING DATA,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 7A.
W88-03831

ART OF LAKE RESTORATION,
University of East Anglia, Norwich (England).
B. Moss.
New Scientist NWSCAL, Vol. 113, No. 1550, p 41-43, March 1987, 1 fig, 7 photo.

Descriptors: *Agricultural runoff, *Lake restoration, *Algae, Norfolk Broads, *Eutrophication, *Submerged plants, *Biomanipulation, England, Nitrates, Phosphorus removal, Costs, Nutrients.

Restoration of lakes overrun by algae is an extremely complicated task. The 50 or so ancient flooded peat pits called the Norfolk Broads in East Anglia, England were once clear lakes but now are overgrown with algae. As a result once abundant submerged plants noted for their attractiveness have almost disappeared. The main cause of this explosive growth of algae appears to the influx of nutrients from nearby population centers and agricultural activities. Some progress in lake restoration was achieved by controlling the inflow of nutrients to the lake. However, the nutrients already in the lake, phosphate, for example, recycles and can only be removed by physically removing the lake sediment. Also it is difficult to restrict the supply of nitrogen to the lake. Nitrate ion, being very soluble, is difficult to remove. A better solution for lake restoration is the so-called 'biomanipulation'. This procedure is not only ecologically more sound but also less expensive. It is suggested that refuges be provided for the grazing water fleas which feed on the algae as a technique to restore the ailing lakes towards their original conditions. (Ray-PTT)
W88-03849

PILOT TESTING FOR COMBINED TREATMENT OF LEACHATE FROM A DOMESTIC WASTE LANDFILL SITE,
Dayton and Light Ltd., West Vancouver (British Columbia).
For primary bibliographic entry see Field 5D.
W88-03853

REGIONAL INFILTRATION/INFLOW STUDY SOLVES WET WEATHER SEWER PROBLEMS,
East Bay Municipal Utility District, Oakland, CA.
For primary bibliographic entry see Field 5D.
W88-03857

GENERAL REMARKS ON PHOSPHORUS SOURCES IN AREAS SUSCEPTIBLE TO EUTROPHICATION, WITH PARTICULAR REFERENCE TO THE NORTHERN ADRIATIC COAST,
Montedison Polimeri S.p.A., Milan (Italy).
G. Bressan.
Science of the Total Environment STENDL, Vol. 55, p 229-242, 1986. 3 tab, 18 ref.

Descriptors: *Phosphates, *Farm wastes, *Phosphorus removal, *Water pollution control, *Detergents, Eutrophication, Wastewater treatment, Italy, Cost-benefit analysis, Agricultural runoff.

The question of phosphates in the environment and their role in marine eutrophication is the subject of political and technical debate. Phosphates are often the main object of attention because phosphorus is the only nutrient which can be controlled technically and economically. Approaches to the phosphate problem have been quite different. In some countries the aspect of detergent phosphates is stressed, as a phosphorus source which can be easily controlled by legislation. Nevertheless, detergent reformulation involves new risks for the receiving waters and drinking water supplies. In other countries the main efforts are based upon sewage treatment and dephosphatation. Cost/benefit aspects of these strategies are examined in the particular case of the Northern Adriatic coast. This cost: benefit assessment indicated that chemical treatment of sewage, can remove phosphorus by intervention in urban and livestock sources in quantities that are much higher than those removed by severe measures on detergents. The relative cost of this treatment is acceptable and the action time short. An integrated approach, which combines a moderate intervention on detergents, chemical sewage treatment to remove phosphorus, and control of agriculutural contributions, particularly those from livestock breeding forms is advocated. (Ray-PTT)
W88-03861

ECOLOGICAL MODELS AS SUPPORT SYSTEMS TO DECISIONS IN LAKE MANAGEMENT PLANNING,
Pavia Univ. (Italy). Centro di Ricerca sulle Acque.
S. Teruggi, and V. Vendegna.
Science of the Total Environment STENDL, Vol. 55, p 261-273, 1986. 3 fig, 39 ref.

Descriptors: *Mathematical models, *Lake restoration, *Eutrophication, Model studies, Water pollution control.

The quantitative prediction of lake eutrophication and the evaluation of the necessary recovery inter-

ventions can be effected by means of different modeling approaches. The distinctive features of the main categories of existing eutrophication models are examined: stochastic input-output models; simulation of basic ecological functions simplified to a two-box model; finer simulation of food chains. The space-time modeling of mass transport is also dealt with. The practical applicability for each modeling technique is given with regard to aspects of lake pollution for which a forecast is required and to the measures which need to be established in order to keep the lake within the predetermined quality standards. (Author's abstract)
W88-03863

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W88-03911

POTENTIAL GROUNDWATER IMPACTS FROM CHEMIGATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-03938

STATE WATER QUALITY PLANNING ISSUES: FINAL REPORT.
Council of State Governments, Lexington, KY.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183190/AS. Price codes: A06 in paper copy, A01 in microfiche. September 1982. 109 p. Project No. OWRT C-90151-U(0487) (1).

Descriptors: *Planning, *Water law, *Political constraints, *Institutions, Organizations, Governmental interrelations, Political aspects, Local governments, State jurisdiction, Water quality management, Water policy, Management, Water management, Federal jurisdiction, Federal Water Pollution Control Act, Land use.

Section 208 of the federal Water Pollution Control Act of 1972 recognized the multijurisdictional nature of water quality management. However, it fell far short of achieving the objectives of coordinating local, state, and federal planning and also coordinating water planning with land use planning and regulation. It is necessary to develop a new national water policy consensus based on shared responsibility with the federal government as coordinator. In the past the states and local governments have been reluctant to enact pollution control measures for several reasons: expense, curtailment of businesses, and government intervention into local issues. This inaction has led to federal intervention. Although clean water standards are a national issue, the federal government should not dominate the programs. States have the organizational structure and resources to deal with water problems. The traditional local control of land use can be reassigned to the states. Multicommunity regional organizations are suggested for managing water quality issues. This requires surrendering some of the state and local governmental authority. (Cassar-PTT)
W88-03939

ENGINEERING APPROACHES FOR LAKE MANAGEMENT; VOLUME 1: DATA ANALYSIS AND EMPIRICAL MODELING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W88-03983

ENGINEERING APPROACHES FOR LAKE MANAGEMENT; VOLUME 2: MECHANISTIC MODELING,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W88-03984

ALTERNATIVE MANAGEMENT OPTIONS FOR THE CONTROL OF DIFFUSE PHOSPHORUS LOADS TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Agronomy.
T. J. Logan, and D. L. Forster.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 122 223. Price codes: A04 in paper copy, A01 in microfiche. November 1982. 46 p, 7 fig, 10 tab, 21 ref.

Descriptors: *Water quality control, *Fate of pollutants, *Phosphorus, *Agriculture, Lake Erie, Nonpoint pollution sources, Fertilizers, Corn, Soybeans, Wheat, Phosphates, Soil conservation, Tillage, Farm management, Nutrients.

Available phosphorus soil test levels in Ohio and Michigan agricultural soils have increased steadily since 1960's. These increases are reported by county for those counties in the Lake Erie Basin of these two states. An economic analysis of phosphate fertilizer use in Ohio Lake Erie Basin counties for corn, soybeans and wheat shows that there is an overuse of phosphate on corn and insufficient P fertilization of soybeans. P fertilizer use on wheat is at the economic optimum. The dissolved and particulate phosphate load reduction which could be obtained by reducing available P in agriculture soils from their 1980 levels down to the sufficiency level for corn and soybean were estimated for the Ohio and Michigan Lake Erie Basin counties. Reductions were small compared to the reductions which could be achieved with conservation tillage but could become more significant if available phosphorus levels in basin agricultural soils continue to rise. The costs and phosphorus reductions obtainable with a wide range of agriculture management practices were compared. Conservation tillage offered the most cost-effective means of greatly reducing the agricultural diffuse phosphorus load to Lake Erie. (Author's abstract)
W88-03987

CONTROL OF POLLUTANTS IN WASTE WATER,
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
W. A. Telliard, M. B. Rubin, and D. R. Rushneck.
Journal of Chromatographic Science JCHSBZ, Vol. 25, No. 8, p 322-327, August 1987. 1 fig, 1 tab, 3 ref.

Descriptors: *Environmental Protection Agency, *Water pollution control, *Wastewater quality, *Regulations, *Water quality control, Federal Water Pollution Control Act, Biological oxygen demand, Suspended solids, Chemical analysis.

Under amendments to the Federal Water Pollution Control Act and Clean Water Act, the United States Environmental Protection Agency (EPA) is required to restore and maintain the chemical, physical, and biological integrity of the nation's waters. A primary task associated with this effort is to eliminate or control the discharge of industrial pollutants into the nation's waterways. An overview is given here of the process that EPA uses to regulate these discharges. The initial implementation of the Federal Water Pollution Control Act (FWPCA) focused on controlling 'conventional' pollutants, such as biochemical oxygen demand (BOD) and total suspended solids (TSS). The current implementation strategy for the FWPCA and the Clean Water Act (CWA) is based on control of not only the conventional pollutants, but also on control of toxic organic pollutants, toxic metal pollutants, nonconventional pollutants, or any other pollutants determined to be in the discharge in significant quantities. In controlling these pollutants, EPA gathers technical data, including the results of analyses of wastewater samples. For the organic pollutants, nearly all of these data are the result of chromatographic analyses using a variety of detectors. (Author's abstract)
W88-04002

TESTING FOR GROUNDWATER CONTAMINATION AT HAZARDOUS WASTE SITES,
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5A.
W88-04003

CHROMATOGRAPHIC MONITORING METHODS FOR ORGANIC CONTAMINANTS UNDER THE SAFE DRINKING WATER ACT,
Environmental Protection Agency, Cincinnati, OH. Office of Drinking Water.
For primary bibliographic entry see Field 5A.
W88-04004

EFFECTIVE COMMUNICATION WITH THE PUBLIC ON WATER POLLUTION CONTROL ISSUES,
Water Pollution Control Federation, Alexandria, VA.
Q. Brown.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 10, p 851-855, October 1987.

Descriptors: *Public policy, *Water pollution control, *Education, Public participation, Environmental protection, Information exchange.

The scientific and engineering community will be dealing over the next 20 years with the most critical issues in water pollution control that the world has faced. Disappointments are likely to occur; when at each and every obstacle preservation of scientific credibility is a major issue. Credibility, in part, is preserved by frequent and effective communication. A better way is needed to relate critical messages to the public. The public's first major concern about the environment was because of the publishing of Silent Spring' by Rachel Carson. Books and information exchange caused the public to care about environmental issues and to understand those issues; the scientific community discovered that the message believed is the one communicated best. Now is the time to begin educating the public. The scientific and engineering community needs an answer for the public on 'how clean is clean,' and on the rational ways in which industry can be allowed to do the things that it must do while maintaining a healthy society that is as risk-free as possible. Six issues - reregulation, pricing policy, groundwater, acid rain, nonpoint source pollution, and hazardous wastes - are on the agenda, for educating the public. There are two horns to the communication dilemma. Effective communications of poorly supported or self-promotional positions can produce results - results damaging to a greater good. Too often bad policy advocates know they can push their opinions if they sell it cleverly enough. The other horn of the dilemma is that the good policy advocates sometimes believe they do not have to sell it at all. The time has come when good policy must be sold. Now, the public may or may not make the final decision on some of these issues, although through Congress they can certainly effect change. If the public is given good information, they end up making rational decisions. (Lantz-PTT)
W88-04067

ALKALINE APPROACH TO TREATING COOLING TOWERS FOR CONTROL OF LEGIONELLA PNEUMOPHILA,
Pittsburgh City Water Dept. PA.
S. J. States, L. F. Conley, S. G. Towner, R. S. Wolford, and T. E. Stephenson.
Applied and Envrionmental Microbiology AEMIDF, Vol. 53, No. 8, p 1775-1779, August 1987. 2 fig, 3 tab, 41 ref.

Descriptors: *Bacteria, *Microbiological studies, *Water pollution control, *Fate of pollutants, *Cooling towers, *Chlorination, *Hydrogen ion concentration, *Public health, Alkalinity, Chlorine, Water treatment, Disinfection.

Earlier field and laboratory studies have shown that Legionella species survive and multiply in the pH range 5.5 to 9.2. Additionally, the technical feasibility of operating cooling towers at elevated alkalinities and pH had previously been documented by published guidelines. The guidelines indicate that these conditions facilitate corrosion control and favor chlorine persistence which enhances the

effectiveness of continuous chlorination in biofouling control. This information suggests that control of Legionella species in cooling towers can be accomplished by operating the towers under alkaline conditions. To test this possibilty, water samples were collected over a period of months from a hospital cooling tower. The samples were analyzed for a variety of chemical parameters. Subsamples were pasteurized and inoculated with non-agar-passaged Legionalla pneumophila which had been maintained in tap water. Correlation of subsequent Legionella growth with corresponding pH and alkalinity values revealed statistically significant inverse associations. These data support the hypothesis that operating cooling towers outside of the optimal conditions for Legionella growth (e.g., at elevated alkalinities and a pH greater than 9) may be a useful approach to controlling growth in this habitat. (Author's abstract)
W88-04083

INADEQUACY OF THE EUCARYOTE INHIBITOR CYCLOHEXIMIDE IN STUDIES OF PROTOZOAN GRAZING ON BACTERIA AT THE FRESHWATER-SEDIMENT INTERFACE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W88-04085

TALE OF TWO WASTES,
PPG Industries, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W88-04090

STATUS OF GROUNDWATER POLLUTION IN THE SAN GABRIEL VALLEY, CALIFORNIA,
For primary bibliographic entry see Field 5B.
W88-04093

WATER QUALITY INDEX APPLIED TO THE CLASSIFICATION AND ZONING OF AL-JAYSH CANAL, BAGHDAD - IRAQ,
Biological Research Center, Baghdad (Iraq).
M. Y. Al-Ani, S. M. Al-Nakib, N. M. Ritha, A. M. Nouri, and A. Al Assima.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 4, p 305-319, May 1987. 3 fig, 6 tab, 6 ref.

Descriptors: *Water quality index, *Water quality standards, *Impaired water use, *Data interpretation, *Al-Jaysh Canal, Baghdad, Iraq, Zoning, Classification, Discharge measurement, Seasonal variation, Canals, Water quality, Water quality management.

A simplified model of the Water Quality Index (WQI) technique is applied to classify and zone the Al-Jaysh Canal in Baghdad, Iraq. Water quality classifications and standards setting systems are used to classify the water source for various uses including irrigation, livestock watering, fishing, and the support of aquatic life. These classifications represent the minimum required characteristics of the water so that no adverse effects results from the water use. Seasonal variations were taken into account in assigning WQI values to designated zones of the canal. The WQI values decline with the reduction of flow rate; constant discharge is required in the canal to maintain good water quality. Water in zones with low WQI values is used by residents for garden irrigation, but plant growth is of lower quality. (Wood-PTT)
W88-04120

BACTERIAL QUALITY OF BOTTLED WATER,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
P. V. Scarpino, G. R. Kellner, and H. C. Cook.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 4, p 357-367, May 1987. 2 tab, 17 ref.

Descriptors: *Bottled water, *Bacteria, *Bacterial analysis, *Water quality standards, *Water quality, Water quality control, Coliforms, Pollutants, Water analysis, Microbiological studies, Drinking water.

The bacterial quality of a total of 204 water samples representing 22 brands of bottled waters (both domestic and imported) obtained from retail outlets in the Cincinnati, Ohio, area is examined using the heterotrophic plate count and the total coliform multiple-tube fermentation and membrane filtration techniques. After 48 hours at 35 dC, 27% of the samples of domestic bottled waters examined had bacterial heterotrophic plate counts in excess of 500 colony-forming units (CFU) per milliliter (ml), with the majority of these in the 1000 to 100,000 range, whereas 73% contained fewer than 500 bacteria as CFU per ml. All of the three imported brands had bacterial levels below 500 CFU/ml. Extended incubation of bacterial plates at room temperature for seven days resulted in a 17.3% increase in bacterial counts in excess of 500 CFU/ml, with the greatest predominance of recovery occurring in the 1000 to 100,000 range. No total coliforms were detected in any bottled water examined, but pigmented non-coliform bacteria were found to constitute a major portion of the bacterial flora in bottled water with high bacterial numbers (i.e., > 500 CFU/ml). It is concluded that the bacterial standards for bottled waters should be based not only on the total coliform determination, but also upon a bacterial heterotrophic plate count of no more than 500 CFU/ml after protracted incubation times longer than 48 hours. (Author's abstract)
W88-04122

PROTECTING GROUNDWATER FROM VIRAL CONTAMINATION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
R. B. Thurman, and C. P. Gerba.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 4, p 369-388, May 1987. 5 fig, 4 tab, 21 ref. USEPA Contract CR-811147.

Descriptors: *Groundwater quality, *Groundwater pollution, *Fate of pollutants, *Soil modification, *Soil water, *Viruses, Enteroviruses, Wastewater pollution, Wastewater treatment, Wastewater, Domestic wastes, Water quality control, Water quality, Groundwater, Soil columns, hydrogen ion concentration.

During land application of domestic wastewater, pathogenic enteric viruses may enter the groundwater. Soil modification to enhance virus removal as a method of groundwater protection is described. Inorganic substances were added to a column of sandy loam to assess their ability to enhance the removal of coliphage MS-2 and poliovirus from tapwater and secondarily treated sewage. Aluminum metal, magnesium oxide and magnesium peroxide, when added to the soil significantly enhanced virus removal above that observed in control columns. Powdered metallic aluminum caused an average decrease of greater than five logs in virus concentration, while control columns containing no aluminum showed only a two log decrease. Significant reduction in the number of viruses continued in test columns during five weeks of intermittent flooding. The efficiency of virus removal due to soil additive declined toward the end of the flooding period. Aluminum metal did not significantly change the pH of the column percolate and was not leached in significant amounts from the soil used in this study when pH 2-3 water was passed through the column for 38 days. Both magnesium dioxide and magnesium peroxide, while effective in virus removal, significantly increased the pH of the column percolate. (Author's abstract)
W88-04123

TRACE-METAL AND ORGANOCHLORINE RESIDUES IN SEDIMENTS OF THE UPPER ROCKAWAY RIVER, NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W88-04151

AIR STRIPPING TREATMENT FOR REMOVAL OF VOLATILE ORGANIC CHEMICALS: A CASE STUDY OF BURLINGTON, MASSACHUSETTS,
Metcalf and Eddy, Inc., Wakefield, MA.
For primary bibliographic entry see Field 5F.
W88-04161

WHAT'S HAPPENING WITH WATER: INDUSTRY DIRECTION - LOOKING TO THE FUTURE,
Becher-Hoppe Engineers, Inc., Wausau, WI.
For primary bibliographic entry see Field 5F.
W88-04162

VOC REMOVAL FROM GROUNDWATER - A CASE HISTORY,
Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, PA.
J. L. Latsha.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 5, p 6-9, September-October 1987. 2 fig, 6 tab.

Descriptors: *Volatile organics, *Groundwater pollution, *Cleanup operations, *Water pollution treatment, Air stripping, Water treatment, Activated carbon, Ultraviolet radiation, Costs, Economic aspects.

The groundwater at a large industrial site had become contaminated with volatile organic compounds (VOC's) from leaking underground storage tanks and transfer pipes. The industry is continuously pumping at least 250 gpm from one of its wells to prevent the migration of groundwater contaminated with VOC's into noncontaminated aquifers. The groundwater was treated with a granular activated carbon system (GAC) which was being rented for approximately $10,000/month. Feasible alternatives were investigated to minimize the cost of treatment. It was preliminarily determined that air stripping of the VOC's followed by adsorption of residual VOC's onto GAC is the most cost-effective method of groundwater treatment. Stripping tower design considerations, granular activated carbon units, and UV units are discussed with respect to cost and design considerations. (Lantz-PTT)
W88-04175

OPERATIONAL WATER QUALITY MANAGEMENT: PROBLEM CONTEXT AND EVALUATION OF A MODEL FOR RIVER QUALITY,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck, and B. A. Finney.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2030-2042, November 1987. 9 fig, 1 tab, 51 ref. NSF Grant No. INT-8420091.

Descriptors: *Water quality management, *Rivers, *Model studies, Water quality, Nitrates, Ammonium, Water pollution control, Dissolved oxygen, Chlorophyll a, River flow, Algae, Ecosystems.

In river basins where water is used intensively and by many activities and facilities, the essential questions of water quality management are changing from being issues of planning alone to being problems of operational decision making. In the past 10 years in the United Kingdom, for example, the technology, economics, legislation, and institutional structure of management have all changed substantially. Together these changes have overturned the traditional assumptions made about the nature of managing river water quality. A case study in operational water quality management is based on a dynamic model for stream discharge and quality covering a 54-km stretch of the Bedford Ouse River in England. The model describes interactions among biochemical oxygen demand, dissolved oxygen, ammonium N, nitrate N, and chlorophyll a concentrations at various points along the river; preliminary identification results are presented using daily time series data for the whole of 1974. The behavior of the river, which relates the effects of a major upstream discharger to a downstream abstractor, is dominated by the dynamics of algal population growth and mortality. In addition to the presentation of these results the technical, economic, and policy questions central to the practical feasibility and potential of operational water

quality management are discussed. This includes questions in quantifying the stochastic, dynamic aspects of river basin management, the development of improved operating strategies, and the development of operational decision support systems. (Author's abstract)
W88-04180

USE OF BIOLOGICAL CONTROLS FOR MANAGING GREAT LAKES DISTURBANCES,
State Univ. of New York Coll. at Oswego. Research Center.
For primary bibliographic entry see Field 4A.
W88-04213

CONTAMINANT MANAGEMENT STRATEGIES FOR THE GREAT LAKES: OPTIMAL SOLUTIONS UNDER UNCERTAIN CONDITIONS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. D. Fontaine, and B. M. Lesht.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 2, p 178-192, 1987. 8 fig, 6 tab, 14 ref, append.

Descriptors: *Water pollution control, *Great Lakes, *Water quality control, Optimization, Phosphorus, Costs, Model studies, Cost-benefit analysis, Pollution load.

Optimization, uncertainty analysis, and mass balance modeling techniques were combined into a framework that can help decision makers identify cost-effective load reduction methods for achieving acceptable contaminant concentrations in the Great Lakes. The utility of the framework is demonstrated by deriving an optimal phosphorus load reduction plan for the Great Lakes. An optimal plan is defined as the least-cost approach that can achieve desired phosphorus concentrations in all Great Lakes basins under realistic, stochastic phosphorus loading and settling rates. The analysis suggests that implementation of phosphorus load reduction measures recommended in the U.S. - Canadian 1978 Great Lakes Water Quality Agreement, its 1983 supplement, and other plans that do not account for environmental uncertainty may be sub-optimal. Compared with the load reduction strategies of the 1978 Water Quality Agreement and its supplement, implementation of the optimized load reduction strategy would lead to substantial annual cost savings and an increased probability of achieving desired phosphorus concentrations. Results emphasize the importance of quantitatively accounting for environmental uncertainty in management models. (Author's abstract)
W88-04220

SUBSURFACE SEAWATER INTRUSION BARRIER ANALYSIS,
Miyazaki Univ. (Japan). Dept. of Civil Engineering.
S. Sugio, K. Nakada, and D. W. Urish.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 767-779, June 1987. 12 fig, 24 ref.

Descriptors: *Saline water intrusion, *Saline water barriers, *Coastal aquifers, *Japan, Computer models, Saline water, Model studies, Groundwater management, Mathematical analysis, Hydraulic structures.

Seawater intrusion barriers are being constructed in the coastal aquifers of Japan based on the results of a computer model employing finite difference numerical techniques. This model provides a practical design and management tool for predicting the likelihood of seawater intrusion through a semipervious subsurface barrier in an unconfined coastal aquifer. The analysis assumes an abrupt interface, the Dupuit approximations, and various simplifying boundary conditions. The movements of both the water table and the freshwater-saltwater interface are numerically simulated in the unsteady state. The computed results are validated with observations obtained from a vertical two-dimensional sand box model. The application of the computer model is illustrated by a site-specific analysis for a proposed subsurface barrier location in a limestone coastal aquifer on Okinawa-jima Island in the Western Pacific Ocean. It was found that the subsurface barrier is able to delay seawater intrusion for about 2 mo. under critical conditions of continual pumping of the aquifer without recharge. The subsurface barrier is technically feasible and is a viable solution to the problem of seawater intrusion in coastal aquifers. (Author's abstract)
W88-04237

HYPOLIMNETIC WITHDRAWAL IN TWO NORTH AMERICAN LAKES WITH ANOXIC PHOSPHORUS RELEASE FROM THE SEDIMENT,
York Univ., Downsview (Ontario). Faculty of Science.
G. K. Nurnberg, R. Hartley, and E. Davis.
Water Research WATRAG, Vol. 21, No. 8, p 923-928, August 1987. 3 fig, 5 tab, 14 ref.

Descriptors: *Path of pollutants, *Selective withdrawal, *Water pollution sources, *Hypolimnetic withdrawal, *Lakes, *Phosphorus, *Anoxia, *Lake restoration, Water quality control, Eutrophication, Hypolimnion, Lake sediments.

Hypolimnetic withdrawal has been used to decrease eutrophication in two Connecticut lakes. This restoration technique is based on the forced discharge of nutrient-rich bottom waters in lakes with anoxic hypolimnia, while surface outflows are dammed. Internal phosphorus load amounted to 600 mg/sq m/summer before withdrawal. Most of this load probably originated from the sediment since the experimentally determined sediment phosphorus release rates of 2-12 mg/sq m/day can account for the internal load. The smaller lake responded to hypolimnetic withdrawal with decreasing epilimnetic and hypolimnetic phosphorus concentrations, decreased anoxia and internal loads. The larger lake also showed a tendency towards improvement which was not statistically significant. (Author's abstract)
W88-04254

RESTORATION OF HEAVILY POLLUTED BRANCHES OF THE SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
A. A. Z. DouAbul, J. K. Abaychi, M. K. Al-Asadi, and H. Al-Awadi.
Water Research WATRAG, Vol. 21, No. 8, p 955-960, August 1987. 1 fig, 5 tab, 8 ref.

Descriptors: *Water pollution treatment, *Shatt al-Arab River, *Iraq, *Water pollution control, *Pollutant identification, Cleanup operations, Water quality, Chemical oxygen demand, Biological oxygen demand, Hydrogen ion concentration, Hydrogen sulfide, Ammonia, Nitrates, Phosphates, Nitrites, Restoration.

The water quality of the heavily polluted branches of the Shatt al-Arab River at the City of Basrah was studied in an attempt to evaluate the effectiveness of a proposed flushing system. It was found that the waters contained very low levels of dissolved oxygen and relatively high amounts of both COD and BOD. The annual average water quality parameters for Basrah Branches were dissolved oxygen 3.4 ppm; pH 7.67; hydrogen sulfide 1.4 ppm; ammonia 97 micrograms-at. N/L; COD 15.9 mg/L; BOD 12.7 mg/L; dissolved silicates 202 micrograms-at. Si/L; dissolved reactive phosphate 13.4 microgram-at. P-PO4(3-)/L; nitrate 10.4 microgram-at. N-NO3(-)/L; nitrite 2.1 microgram-at. N-NO2(-)/L and chlorophyll-a 14.3 mg/cu m. Based on these calculations, it was concluded that the proposed system which would involve the establishment of pump-like circulation to achieve the required renewal of water, would be effective; within the flushing cycle all of the parameters would meet water quality goals. This flushing system would have no appreciable adverse effect upon water quality because the river discharges a high volume of water annually. However, it has been recommended that the deposited sludge be dredged to a minimum depth of 50 cm. (Lantz-PTT)
W88-04258

FLOW VARIABLE DISCHARGE PERMITS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
R. R. Noss, and I. Gladstone.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 761-766, October 1987. 5 fig, 1 tab, 8 ref.

Descriptors: *Water quality control, *Discharge permits, *Water quality standards, *Flow discharge, *Regulations, *Water pollution control, Discharge limitations, Water pollution, Water pollution sources, Permits, Water quality management.

Current approaches to calculating discharge limitations and the use and intent of water quality standards are examined. Flow variable discharge permits, in which the amount of pollutant that may be discharged is based on the magnitude of the flow in the stream, are introduced as an alternative permit strategy that could reduce the cost of pollution control in certain instances while still meeting in-stream water quality objectives. Several possible designs of flow variable discharge permits are presented to show the flexibility of the concept; for example, permits can be based on instantaneous flows, seasonal flows, trigger values, and ranges of flows. (Author's abstract)
W88-04275

DESIGN OF AN INDEX OF WATER QUALITY,
Auburn Univ., AL. Dept. of Accounting and Finance.
S. H. Dinius.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 833-843, October 1987. 5 fig, 5 tab, 16 ref.
Department of the Interior Project A-054-ALA.

Descriptors: *Index of Water Quality, *Project planning, *Water quality management, *Water quality standards, Water quality, Water pollution control, Four-Round Delphi equation, Mathematical equations, Pollutants, Water use, Mathematical studies, Biological oxygen demand, Coliforms, Hydrogen ion concentration, Alkalinity, Chlorides, Dissolved oxygen.

The formulation of an Index of Water Quality which evaluates the level of pollution in fresh water is described. A Four-Round Delphi equation, using a panel of seven nationally recognized water scientists, was performed to ascertain the pollutants to be included in the index, the relationship between the quantity of these pollutants in the water and the resulting quality of the water, and the importance of each pollution variable to each water use as well as to overall pollution. The pollution parameters considered were dissolved oxygen, 5-day BOD, coliform count, e. coli, pH, alkalinity, hardness, chloride, specific conductivity, temperature, and color. A multiplicative index was used to bring the pollutants together into one system. (Wood-PTT)
W88-04284

BISCAYNE AQUIFER CONTAMINATION: CLEANUP AND PREVENTION,
CH2M Hill, Emeryville, CA.
U. P. Singh, and J. E. Orban.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 879-888, October 1987. 3 fig, 6 tab, 9 ref.

Descriptors: *Water quality management, *Regulations, *Fate of pollutants, *Cleanup operations, *Water pollution prevention, *Water quality control, *Cleanup, *Biscayne Aquifer, Water pollution sources, Decontamination, Drinking water, Florida, Aquifers, Hazardous materials, Groundwater pollution, Standards.

The Biscayne Aquifer is the sole source of drinking water for approximately three million residents of southeastern Florida. Nine hazardous waste sites on the EPA National Priority List overlie this aquifer. Extensive investigation of an 80 square-mile area in metropolitan Miami detected low to moderate levels of toxic contaminants in the

groundwater, with volatile organic chemicals the most prevalent. The Centers for Disease Control concluded that contamination of the aquifer within the study area poses a serious potential threat to public health. Recommendations for source control and cleanup were partially carried out. The top few feet of soil at the Miami Drum site were excavated and relocated; groundwater encountered during excavation was withdrawn and treated, and the Northwest 58th Street Landfill was closed. Recovery and treatment of groundwater from the contaminated area was the recommended measure, and was approved by the EPA and state and local agencies. A preventative action program for the Biscayne Aquifer region was also recommended for implementation by local agencies. This program consists of regulations, waste management practices, construction and treatment guidelines, and public information activities and materials. Implementing this program will help keep the Biscayne Aquifer water drinkable far into the future. (Author's abstract)
W88-04291

SOIL CONSERVATION PRACTICES AND WATER QUALITY: IS EROSION CONTROL THE ANSWER,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 4D.
W88-04293

OPTICAL HETEROGENEITY IN GREEN BAY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 2H.
W88-04298

MONTE CARLO STUDIES OF SAMPLING STRATEGIES FOR ESTIMATING TRIBUTARY LOADS,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5B.
W88-04315

PROCESS CONSIDERATIONS IN BIOLOGICAL TREATMENT OF LOW CONCENTRATION WASTEWATERS. II. DYNAMICS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5D.
W88-04339

LAKE EUTROPHICATION MANAGEMENT MODEL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Somlyody.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 711-719, 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Eutrophication, *Water quality management, *Model studies, *Lake Balaton, *Hungary, Mathematical studies, Mathematical models, Nutrients, Phosphorus, Chemical precipitation, Reservoirs.

An eutrophication management optimization model (EMOM) was developed and applied for Lake Balaton, a typical shallow water body, to establish a short term control strategy. It incorporates a stochastic load response model which was derived from the Monte Carlo type usage of a four-compartment, four-box dynamic lake eutrophication model after developing synthetic time series generators for forcing functions. EMOM also includes a planning mode nutrient loading model, which accounts for various uncertainties and stochastic effects. Major control options are phosphorus precipitation in existing sewage treatment plants, and the construction of pre-reservoirs. Among alternative objective functions and models formulated, a linearized expectation - variance model captures the major stochastic features of the problem. The 'optimal' short term strategy was worked out for Lake Balaton, on the basis of an optimization management model incorporating an aggregated lake eutrophication model and a planning type nutrient loading model. The basin-to-basin differences in the trophic state, interbasin mass exchange, internal load and the influence of stochastic changes on water quality are the most important factors associated with in-lake processes which appear in the management model. (Lantz-PTT)
W88-04356

OPTIMIZATION OF REGIONAL WATER QUALITY MONITORING STRATEGIES,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
J. Pinter, and L. Somlyody.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 721-727, 1987. 1 fig, 2 tab, 12 ref.

Descriptors: *Network design, *Monitoring, *Optimization, *Lake Balaton, Hungary, Water quality management, Nutrients, Mathematical models, Model studies, Networks.

A conceptual framework was developed for optimizing the operation of regional monitoring networks which assist water quality management. The primary objective of the studied network is to determine the annual nutrient load carried into a lake by its tributaries. Following the description of the basic (single time - period, single water quality indicator) model, several extension possibilities and computational aspects are highlighted. The suggested methodology is illustrated by a numerical example, concerning the surveillance system on the tributaries of Lake Balaton (Hungary). (Author's abstract)
W88-04357

STUDY ON REAERATION IN RIVER CASCADES,
For primary bibliographic entry see Field 5B.
W88-04360

MODELING OF BIOLOGICAL PROCESSES IN THE SUBSURFACE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-04361

PREDICTION OF WATER QUALITY IN A FUTURE WATER SUPPLY RESERVOIR,
Energoprojekt, Belgrade (Yugoslavia).
A. Filip, and M. Cvjetkoviv.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 793-802, 1987. 10 fig, 1 tab, 5 ref.

Descriptors: *Water quality, *Reservoirs, *Water supplies, Biological oxygen demand, Dissolved oxygen, Prediction, Water temperature, Phosphates, Model studies.

The water quality in a future water supply reservoir has been predicted using mathematical modelling based upon data measurements of water, climate, watershed characteristics, reservoir morphology and hydraulics. The following water quality parameters were modelled: water temperature, dissolved oxygen concentration, algal content, BOD, phosphate concentration, organic sediment, etc. One and five-year periods were simulated under oligotrophic, mesotrophic and eutrophic water body assumptions to follow the development of water quality. For wet, average and dry weather conditions and most probable mesotrophic productivity development, the water body quality in time was simulated. Based on simulation results, the withdrawal conditions, as amounts and depths, were defined. These results were used for selection of the optimal intake level with respect to the set criterion for dissolved oxygen concentration. On the basis of the results obtained by simulation it may be concluded that a strict adherence to a set criterion for dissolved oxygen leads to the occurrence of higher algae concentrations in the intake water, giving rise to difficulties in water treatment plant operation. An active measure to compensate for the oxygen deficit in the hypolimnion will be hypolimnetic aeration. (Lantz-PTT)
W88-04363

COAGULATION OF TWO DIFFERENT KINDS OF SURFACE WATER BEFORE INLET INTO LAKES TO IMPROVE THE SELF-PURIFICATION PROCESS,
Amsterdam Water Supply (Netherlands).
C. Van der Veen, A. Graveland, and W. Kats.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 803-812, 1987. 7 fig, 6 tab, 4 ref.

Descriptors: *Water quality control, *Coagulation, *Surface waters, *Self-purification, *Lakes, Drinking water, Water supply, Water management, Eutrophication, Phosphates, Monitoring, Water quality management.

Part of the drinking water demands of the city of Amsterdam and the surrounding district are met by abstraction from nearby Lake Loenderveen that is fed by two different kinds of surface water. The lake itself is subject to rainfall, evaporation and seepage. It acts partly as a stockpiling reservoir (about 2 weeks) and partly as a self-purifying medium (retention time about 100 days). The design and management of the lake are such that a high degree of mixing of the inflowing water is obtained and an almost constant water quality, which greatly facilitates subsequent treatment to obtain high quality drinking water. To combat eutrophication the nutrient-containing water that enters the lake is dephosphated. After a number of years working with an experimental and simplified method in the lake itself, a highly efficient new coagulation and settling plant was constructed. This has been in operation since 1984 and has resulted in improvements in the quality of the lake water. In addition to a considerable reduction in the phosphate content (and that of other nutrients), improvements were registered in a number of other water quality parameters (DOC, heavy metals, color, etc). A similar coagulation and settling system is also used to treat one kind of surface water that is fed into the adjacent Loosdrecht Lakes during dry summer spells. These lakes are of great environmental importance; they are also unique features of the landscape. Pretreatment of the water that flows into the lakes has a substantial effect on the water quality. A monitoring system has been set up to check the resulting improvement. (Author's abstract)
W88-04364

SALINITY CONTROL OF INTERSTATE WATERS IN ARGENTINA,
Instituto Nacional de Ciencia y Tecnica Hidricas, Mendoza (Argentina).
A. Moyano.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 833-838, 1987. 1 fig, 4 ref.

Descriptors: *Salinity, *Water quality control, *Argentina, *Interstate rivers, *Water law, Colorado River, Treaties, Regulations.

Water salinity control in interstate basins is exercised by means of treaties. Such is the case of the Colorado River in Argentina by the Treaty of 26 October 1976. Argentina is made up of 22 member states (provinces). Their respective sovereign powers have been partially delegated in order to create the national government. The sovereign powers the provinces have reserved for themselves guarantee, among other things, their domain and jurisdiction over their waters. The only constitutional means to reach an agreement is by a treaty, and it is by one such agreement that the provinces of Mendoza, Neuquen, La Pampa, Rio Negro, and Buenos Aires divided among themselves the Colorado River waters. However, environmental restoration of soil, flora and water requires constant adjustment, which can be made by agreements that render this possible, or by political decisions that will prevent conflicts among the states. (Lantz-PTT)
W88-04367

UPPER JAMES ESTUARY - A STUDY IN WATER QUALITY MANAGEMENT,
Virginia State Water Control Board, Richmond.
K. C. Das.
Water Science and Technology WSTED4, Vol.

19, No. 9, p 1-7, 1987. 1 fig, 2 tab, 10 ref.

Descriptors: *James River, *Water quality management, *Water pollution control, *Water pollution sources, *Water pollution prevention, Estuaries, Combined sewer overflows, Models, Dissolved oxygen, Nitrification, Saline water intrusion, Denitrification, Eutrophication, Nutrient removal.

Management strategies for maintaining acceptable water quality along the James River are examined. Eleven major discharging municipalities and industries lie within a stretch of twenty-two river miles between Richmond and Hopewell. Water quality problems below the City of Richmond stem from the intermittent discharge from combined sewer overflows (CSOs) coupled with the continuous discharge from the City's sewage treatment plant. The CSOs contribute a large quantity of soluble BOD, suspended solids, settleable solids, and fecal coliforms to the estuary. The City's sewage treatment plant continuously discharges large quantities of ammonia nitrogen and phosphorus, in addition to BOD and suspended solids. To reduce NOD wasteload, allocations should include total Kjeldahl nitrogen. Most of the phosphorus will be converted to orthophosphate during activated sludge treatment before discharge. Intensive data collection during 1983-1985 indicated that nitrification is occurring in the upper reaches. A detailed benthic study showed that nitrification and denitrification are occurring simultaneously suggesting that water quality models should incorporate both processes. SOD should be treated as a variable in the upper estuary. There is an apparent relationship between the nitrification rate and ammonia input, as well as with nitrifying bacteria density. Control of NOD, total nitrogen and phosphorus should be considered in stages. This method of dynamic water quality management is critical to control pollution of the James system on a continuing basis. (Geiger-PTT)
W88-04412

WATER QUALITY CONTROL PLAN FOR WEST MORAVA RIVER BASIN IN YUGOSLAVIA,
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
M. Jovicic, and A. Filip.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 9-18, 1987. 1 fig, 6 tab, 3 ref.

Descriptors: *Water quality management, *Water pollution prevention, *Water pollution sources, *Yugoslavia, *Water pollution control, Water quality control, Wastewater treatment, Monitoring, Cost analysis, Nonpoint pollution sources, Mathematical models.

During one hydrological year, a survey of the ambient waters of the West Morava River Basin was carried out for five characteristic hydrological regimes, together with a survey of the sources of pollution. The pollution sources were also monitored continuously during the year, and socio-economic factors were examined for future reference. The high level of pollution of the ambient waters was primarily due to the increased density of population, development of industry and more intensive agricultural production in the early 1950's. Each polluter affecting the water quality at each surveying station within the watercourse was identified using mathematical modelling. Several measures were proposed to control point sources of pollution including changes in the technological processes of industries, decreasing the other sources of pollution and wastewater treatment. For nonpoint sources of pollution in urban areas the following control measures were proposed: the completion of a sewer system; improvement of hygienic conditions in urban areas; control of civil engineering activities; and construction of treatment plants for solid wastes. For agricultural areas the following were proposed: control of the use of chemicals, especially pesticides; control of erosion processes; and increased development of afforestation areas. A cost analysis for alternative protection measures to control water pollution is discussed. (Geiger-PTT)
W88-04413

HABITAT ELEMENTS IN RIVER BASIN MANAGEMENT AND PLANNING,
Illinois Univ., Urbana. Dept. of Civil Engineering.
E. E. Herricks, and M. I. Braga.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 19-29, 1987. 5 fig, 1 tab, 31 ref.

Descriptors: *Aquatic habitats, *Aquatic insects, *Stream fisheries, *Computer models, *Flow velocity, Water quality management, Water pollution prevention, Larvae, Management planning, River flow, River basins, Model studies, Fish management, Toxicity, Fish toxins, Water quality standards.

Comprehensive river basin management must move beyond narrowly focused programs dealing with water quantity or water quality. A more comprehensive approach to river basin management recognizes that both flow quantity and water quality can be summarized as habitat measures. A number of well developed physical habitat analysis and prediction procedures are presently available. Several computerized systems available from the U. S. Fish and Wildlife Service (Habitat Suitability Index - HSI and Physical Habitat Simulation - PHABSIM) provide macrohabitat definition. A water quality based habitat component was developed which operates effectively for general analysis. With an emphasis on site specific management in the United States, the macrohabitat definition procedures may not meet all river basin management and planning requirements. The results of research which characterizes microhabitat in streams and rivers is reviewed. This research provides a valuable extension to basin management procedures. (Author's abstract)
W88-04414

TEJO 1 - AN INTERACTIVE PROGRAM FOR THE DIVISION OF ESTUARIES INTO HOMOGENEOUS AREAS,
Universidade Nova de Lisboa (Portugal). Coll. of Sciences and Technology.
For primary bibliographic entry see Field 2L.
W88-04416

INSTITUTIONS AND MANAGING THE ENVIRONMENT,
Universidade Federal de Santa Catarina. Florianopolis (Brazil). Dept. of Sanitary Engineering.
D. J. Silva.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 53-58, 1987. 1 fig, 10 ref.

Descriptors: *Water resources developmenmt, *Management planning, *Models, *Conservation, *Social aspects, Environmental policy, Model studies, Information exchange, Institutional constraints, Developing countries, Flooding.

From an understanding of environmental problems which arise from development models and the environmental and social degradation they cause, and based on the theory of the sustainable development of species and ecosystems, a study was made of management models concerning the environment and institutional resources. Partial results of the study indicate the incompatibility of the present forms of management with the adoption of conservative practices four variables were identified as participating directly in an objective function developed for a conservationist institutional structure for environmental management: the nature of the problem; the organization of the societies involved; the existing institutional structure; and, the human and financial resources. As a conclusion, a set of strategic solutions is presented to overcome the conflict. (Author's abstract)
W88-04417

DAMS AND THE ENVIRONMENT,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 6G.
W88-04419

MANAGEMENT OF SURFACE WATER QUALITY IN INDIA,
Saifia Coll., Bhopal (India). Dept. of Limnology.
T. Saify, and S. Nasir Ali.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 87-96, 1987. 2 tab, 7 ref.

Descriptors: *Surface water, *Water quality management, *India, *Water pollution effects, *Fisheries, Water pollution prevention, Eutrophication, Euphotic zone, Algal blooms, Developing countries, Water pollution sources, Water pollution control, River basins, Turbidity, Nutrient removal.

Although India has abundant surface water resources, there are many problems in the maangement of these resources in their natural state. Pollution occurs from the direct disposal of sewage, domestic and industrial effluents, and interference by cattle, along with various direct and indirect anthropogenic activities, such as washing, bathing, swimming, cultivation of aquatic crops and fish farming. For prevention, control and abatement of water pollution throughout the country, the Central Government has passed the Water Prevention and Control of Pollution Act of 1974. The United Nations General assembly has declared the decade 1981-1990 as the International Drinking Water Supply and Sanitation decade. The Government of India has set up the National Environmental Engineering Research Institute at Nagpur for monitoring environmental health. Other means of water quality management are discussed. Developing countries should utilize the increasing eutrophication and pollution to increase fish production by enhancing the euphotic zone of the surface water bodies using suitable reflectors, a method known as Saify's photon impact. (Geiger-PTT)
W88-04421

WATER RESOURCES MANAGEMENT IN THE SEMI-ARID CENTRAL VALLEY OF CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 4B.
W88-04422

WATER RESOURCES PLANNING - A RESEARCH PROGRAM,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 6A.
W88-04424

COMPARATIVE STUDY OF INLAND WATER QUALITY - SAO PAULO (BRAZIL), FRANCE AND ENGLAND,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
R. M. Abreu, and M. R. Guazzelli.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 125-132, 1987. 11 tab, 3 ref.

Descriptors: *Water quality management, *Brazil, *France, *England, *Water pollution control, Comparison studies, Networks, Data interpretation, Hydrologic data collections, Monitoring, Rivers, Stream pollution, Water pollution prevention, Water quality.

Reports on inland water quality are often published in many countries. These reports present the results of monitoring networks and show the evolution of the water pollution control situation in these countries. The data in the reports published in France and England and Wales were compared with similar data surveyed by CETESB (the Brazilian Environmental Protection Agency) in Sao Paulo State, Brazil. Some difficulties had to be overcome regarding adequate data processing to permit the comparison to be made. Moreover, it was necessary to deal with non-updated data. It was concluded that, although some countries such as France and England traditionally have more resources and experience available than Brazil, they have not been able to solve pollution problems in a much more efficient way. (Author's abstract)
W88-04425

DEVELOPMENT OF WATER QUALITY INDICES FOR OPERATIONAL MANAGEMENT,
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
M. A. House, and J. B. Ellis.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 145-154, 1987. 2 fig, 6 tab, 20 ref.

Descriptors: *Water quality management, *Cost analysis, *Surface water, *United Kingdom, *Water quality standards, Evaluation, Management planning, Rivers, Legal aspects, Comparison studies, Potable water, Water treatment, Economic aspects, Water quality control, Guidelines.

The derivation, structure and application of a Water Quality Index (WQI) for the classification of surface water quality is discussed and the efficiency of the developed WQI is compared with the standard United Kingdom classification system of the National Water Council (NWC). The general WQI is developed through the objective and rigorous selection, transformation and weighting of determinants with rating curves based on legal standards and quality directives or guidelines. Three further indices intended for potable supplies and evaluation of toxicity are also discussed. The utility of the developed index for operational management is demonstrated by a comparative study with the NWC classification for a number of rivers in the Greater London region. The flexibility and advantages of a WQI approach in providing potential cost benefit assessments for water quality on both temporal and spatial scales are also highlighted. (Author's abstract)
W88-04427

OPTIMIZATION OF REGIONALIZED WASTEWATER TREATMENT SYSTEMS FOR THE RIVER AVE BASIN,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 5D.
W88-04429

MATHEMATICAL MODELS FOR MIXING AND DISPERSION IN FORECASTING AND MANAGEMENT OF ESTUARINE WATER QUALITY,
Calcutta Metropolitan Development Authority (India).
For primary bibliographic entry see Field 2L.
W88-04430

RIVER BASIN MANAGEMENT IN ENGLAND AND WALES,
Southern Water Authority, Worthing (England).
For primary bibliographic entry see Field 6B.
W88-04433

SOCIO-ECONOMIC DEVELOPMENT LEVELS AND ADEQUATE TECHNOLOGICAL POLICY FOR WATER RESOURCES MANAGEMENT,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-04437

SOCIO-ECONOMIC DEVELOPMENT LEVELS AND ADEQUATE REGULATORY POLICY FOR WATER QUALITY MANAGEMENT,
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
R. Helmer.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 257-272, 1987. 10 tab, 30 ref.

Descriptors: *Water quality management, *Developing countries, *Economic aspects, *Water law, *Water resources development, Water policy, Water pollution control, Water quality standards, Environmental impact statement, Environmental effects.

Rapid industrialization in a substantial number of developing countries has serious implications for the environment and human health and well being. Water resources such as river basins are particularly affected by industrial and municipal waste discharges which have led to severe effects on water quality. Current regulatory policies to cope with this situation are reviewed and their effectiveness compared. Major governmental instruments include legislation, planning instruments such as environmental impact assessment, effluent standards and charges, licensing, specification and subsidization of pollution control installations and direct interventions. In many developing countries the government acts in a dual role as developing agency and regulatory institution at the same time, which allows for introduction of environmental considerations and pollution control measures early in the industrial development process. Often the lack of an experienced and adequately staffed government machinery in the environmental sector hampers the regulatory agencies control function. (Author's abstract)
W88-04438

COMPARISON OF GEOSTATISTICAL METHODS FOR ESTIMATING VIRUS INACTIVATION RATES IN GROUND WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
M. V. Yates, and S. R. Yates.
Water Research WATRAG, Vol. 21, No. 9, p 1119-1125, September, 1987. 11 fig, 28 ref.

Descriptors: *Water quality control, *Groundwater quality, *Viruses, *Groundwater pollution, *Path of pollutants, *Septic tanks, *Mathematical models, Model studies, Human diseases, Public health, Comparison studies, Pollutant identification, Spatial distribution, Regression analysis, Mathematical studies, Statistical methods, Water pollution prevention, Kriging, Drinking water.

Enteric viruses are reponsible for a large number of ground-waterborne disease outbreaks every year. Septic tanks are the most frequently cited causes of groundwater contamination in disease outbreaks, and are probably the major contributors of viruses to the subsurface environment. Controlling the placement of septic tanks such that all viruses would be non-infective by the time the effluent reached drinking water wells would likely reduce the number of waterborne viral disease outbreaks. Described here is the use and comparison of different geostatistical techniques (kriging, cokriging, and combined kriging and regression) to estimate virus inactivation rates in groundwater. These estimates were used with the regional groundwater flow characteristics to estimate septic tank setback distances over a city-wide area. It was found that combined kriging and regression, which eliminates the need for laboratory values of virus inactivation rates by using the linear regression relationship between temperature and inactivation rates, produced comparable results to the other two methods, yet reduced the cost of the analysis considerably. (Author's abstract)
W88-04451

NORTH AND SOUTH AMERICAN STUDIES ON THE POTENTIAL OF COLIPHAGE AS A WATER QUALITY INDICATOR,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W88-04452

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

INFRASTRUCTURE AND THE ENVIRONMENT,
R. Grove-White.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 82, p 349-356, April 1987.

Descriptors: *Policy making, *Environment, *Civil engineering, *Environmental policy, *Political aspects, *United Kingdom, *Water supply, *Sewer systems, *Housing, *Electric power, *Coal, *Energy sources, Natural resources, Sewers, Rehabilitation, Conservation, Investment, Tunnels, Engineering.

Engineers should recognize that the environmental policy dimension is here to stay and will exert increasing influence and support. It must be accepted that environmental pressure groups now reflect an important dimension of public sentiment. It should also be accepted that this will mean somewhat different approaches to infrastructure planning from those which have prevailed in the past. The emphasis will increasingly have to be on making better use of our existing resources. A broad view should be taken by Government when considering the case for public infrastructure investment. There can be crucial medium- and long-term benefits to such investment--socially and environmentally, quite apart from industrial or economic benefits. The best policies for new infrastructure investment are those that have as their main emphasis rehabilitation, and a better use of resources. (Main-PTT)
W88-03608

WATER OVERVIEW,
For primary bibliographic entry see Field 5D.
W88-03609

CERES-MAIZE MODEL AS A POTENTIAL TOOL FOR DROUGHT ASSESSMENT IN SOUTH AFRICA,
Weather Bureau, Pretoria (South Africa).
A. L. du Pisani.
Water S. A. WASADV, Vol. 13, No. 3, p 159-164, July 1987. 1 fig, 4 tab, 9 ref.

Descriptors: *CERES-MAIZE model, *Model studies, *Maize, *Drought, *Rainfall, *South Africa, *Crop yield, Soil water, Prediction, Food crops, Weather data.

An index to characterize drought in such a way that policy makers will have an objective measure to declare areas drought-stricken and to implement subsidy schemes on a fair basis has been sought. The Palmer Drought Severity Index (PDSI) has been found wanting in this respect and more crop specific indices are at present under investigation. A methodology employing the CERES-MAIZE model to assess drought impacts on maize at an early stage in the season has been developed. The model was verified using South African yield data collected at a wide variety of localities ranging in mean annual rainfall from 550 to 870 mm and in yield from 986 to 8,600 kg/ha. Model sensitivity to soil water parameters and planting dates was evaluated. The profile available water (PAW) capacity should preferably be known to within 50 mm to make a good assessment while planting dates as far apart as two full weeks gave similar results. In order to develop a methodology for predicting yield response to drought during the course of the growing season, temperature and rainfall data were analyzed on a monthly basis. The month in the historical record which gave a monthly value nearest the median value of the record was identified and used to synthesize a 'median year'. To assess the impact of early season weather on the crop yield attained in a given season, the model was run with actual weather data up to a given date after which the median year's data were used for the remainder of the growing season. Excellent correlations were found between yield predictions based on the use of observed early season data (up to as early as the end of January) in combination with median data for the remainder of the season and yield predictions based on observed data over the entire season. (Author's abstract)
W88-03770

POLICY ANALYSIS FOR THE NATIONAL WATER MANAGEMENT OF THE NETHERLANDS.
Commissie voor Hydrologisch Onderzoek TNO, The Hague (Netherlands).
For primary bibliographic entry see Field 6C.
W88-03968

GENERAL ASPECTS OF THE POLICY ANALYSIS FOR THE WATER MANAGEMENT OF THE NETHERLANDS (PAWN),
Rijkswaterstaat, The Hague (Netherlands).
K. P. Blumenthal.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 11-24, 3 fig.

Descriptors: *Water policy, *Water management, *The Netherlands, *Economic aspects, Evaluations, Management planning, Cost analysis, Models, Model studies, Water costs, Water quality management, Cost-benefit analysis, Irrigation, Eutrophication, Sensitivity analysis, Project planning.

A major study of the water management of the Netherlands entitled PAWN (Policy Analysis for the Water Management of the Netherlands) was conducted from 1977-1979 in cooperation with the RAND Corporation of the United States and the Delft Hydraulics Laboratory. After a brief description of the water system of the Netherlands, the problems that initiated the PAWN study are examined. The methodology, screening of tactics, policy design, assessment of impacts and sensitivity study of the PAWN investigation are described. As far as financial benefits or prevention of losses are concerned, the PAWN study concluded that agriculture dominates all other sectors. Sprinkling to augment crops appears to be a very cost-effective measure. Many Dutch water boards intend to improve their water management system by enlarging the area that will have access to waters. The Netherlands are envisaging a set of future infrastructural works to improve the national water system. PAWN has shown none of those to be cost effective. PAWN refers national tactics for the improvement of water quality to regional or local tactics that are outside the PAWN scope. A mixture of tactics chosen for each individual lake will be effective in combating eutrophication. PAWN has shown that some environment and nature preservation tactics work better than others. (Geiger-PTT)
W88-03969

ASSESSING IMPACTS OF WATER MANAGEMENT POLICIES,
Waterloopkundig Lab. te Delft (Netherlands).
G. Baarse, and E. Van Beek.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 125-140, 3 tab, 14 ref.

Descriptors: *Environmental impact statement, *Water policy, *Water management, *Management planning, *The Netherlands, Public health, Powerplants, Economic aspects, Agriculture, Water resources development, Social aspects, Drinking water, Regulations, Water costs, Water demand, Evaluations, Project planning.

Impact assessment is the final stage of analysis that was considered in the PAWN (Policy Analysis for the Water Management of the Netherlands) study. In this stage, the impacts of various selected water management policies are estimated. A water management policy is some set of measures to improve water management that represents a national policy for the Netherlands. Impact assessment deals with determining impacts on different impact categories for different situations (cases) to be analyzed. Main impact categories are the user groups and the national impact categories (public health and financial aspects). A case is defined as a combination of some water management policy and a set of scenario type assumptions that affect its performance and impacts. A number of scenario variables have been considered in constructing these cases: external supply (climatological conditions and river discharges); agricultural sprinkling scenario (extent to which sprinkler systems are available to agriculture); and context variables (variables that reflect socio-economic developments). The results of the analysis indicate that, on a national scale, agricultural impacts dominate others. However, local impacts on shipping and powerplants may be substantial. Putting severe restrictions on groundwater use will have a very large impact on the costs and quality of drinking water production and will increase the drinking water demand by industries. (Geiger-PTT)
W88-03978

CONNECTICUT'S WATER SUPPLY PLANS,
Connecticut Dept. of Health Services, Hartford. Water Supply Section.
For primary bibliographic entry see Field 5F.
W88-04159

WATER DISTRIBUTION RECORD KEEPING AND PLANNING APPROACHES: CURRENT UTILITY PRACTICES,
Peer Systems, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 5F.
W88-04160

NEW METHOD FOR QUALITATIVE SIMULATION OF WATER RESOURCES SYSTEMS. 1. THEORY,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 7C.
W88-04177

PUBLIC PARTICIPATION IN WATERSHED MANAGEMENT: COMBINING NOMINAL GROUP PROCESS AND MICROCOMPUTERS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
P. J. Pizor, and S. M. Holler.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 889-896, October 1987. 3 fig, 2 tab, 27 ref.

Descriptors: *Public participation, *Management planning, *Watershed management, *Nominal Group Process, *Computers, Public policy, Public relations, Public opinions, Watersheds, Decision making, Water resources development.

The growing concern for public participation in water resource decision-making has invited researchers to improve and develop reliable and inexpensive techniques for measuring public preferences. It is increasingly clear that traditional participation mechanisms, though useful, are no longer sufficient in providing the level of participation desired by many. A combination of microcomputer technology with Nominal Group Process (a step-by-step process ending in ranked recommendations) offers numerous possibilities for active participatory planning. Efforts at participation occurring through a well developed and defined process cannot be successful without sensitivity to the conceptual, methodological, and pragmatic problems involved. The presentation of an alternative active process technique is prefaced with discussion of the theoretical basis of participatory democracy and the frustration with practical implementation procedures. (Author's abstract)
W88-04292

INSTITUTIONS AND MANAGING THE ENVIRONMENT,
Universidade Federal de Santa Catarina. Florianopolis (Brazil). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W88-04417

USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN RIVER BASIN MANAGEMENT,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W88-04420

WATER RESOURCES PLANNING - A RESEARCH PROGRAM,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
M. A. Santos, and J. R. Costa.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 119-124, 1987. 4 ref.

Descriptors: *Water resources development, *Project planning, *Water policy, *Water quality management, *Water pollution control, Technology transfer, Evaluation, Watersheds, Water pollution prevention, Resources management, Water demand, Water management.

A research project on 'Methodologies for Water Resources Policy Analysis' is under current development at the National Laboratory for Civil Engineering, Portugal. Its main objectives are to develop and test techniques, computational tools and procedures which may help in the design of water resources plans, in the comparison and evaluation of alternative strategies, and in real time drainage basin management and operation. In order to achieve these objectives the technical activity of the project has tackled such water resources problems as the assessment of water availability and demands, the characterization of river water quality and wastewater, water pollution control and river water quality modeling. Also, effective technology transfer from technicians to local, regional and national managers and decision-makers has been tried. The main project activities are summarized, some of the achievements are pointed out, and its most significant results are presented. (Author's abstract)
W88-04424

OASIS SYSTEMS MANAGEMENT,
Economic Center, Water Legislation and Administration, Mendoza (Argentina).
A. V. Bertranou.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 225-230, 1987. 12 ref.

Descriptors: *Water management, *Argentina, *Water resources development, *Latin America, *Developing countries, Management planning, Water policy, Economic aspects, Decision making, Environmental effects, Resources management, Water use, Political aspects, Legal aspects.

'Oasis' is an integrated basis for rational water maangement, and integrated management is a tool for rational decision-making. In the evolution of man's relationship with water, three phases (the uses phase, the resources phase, and the environment phase) and three stages (legal, institutional, and integrative) are identified, which are examined in three areas (Argentina, Latin America, and the world). The challenge of water resources management is the move from fragmented (closed) to complete (open) 'oases, the ultimate goal being to restore man's relationship with nature. Integrated management of water resources is presented as a way of solving the problems that tend to dissociate man from institutions. Integrated management is a versatile tool that goes beyond the limits of disciplines that result in partial views of reality. It is also a specialized tool that promotes a harmonious relationship between natural and cultural sciences. (Author's abstract)
W88-04435

INNOVATIVE FINANCING TECHNIQUES IN A VOLATILE MARKET REQUIRE COOPERATIVE EFFORT,
Gulf Coast Waste Disposal Authority, Houston, TX.
L. J. Davis.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 231-236, 1987. 5 ref.

Descriptors: *Project planning, *Financing, *Water resources development, *Economic evaluation, *Loans, Profit, Subsidies, Legal aspects, Marketing, Economic aspects, Bond issues.

The key to any successful water related project is a successful financing program. The need to develop cooperation and understanding between administrative managers who plan, design and implement the physical program is addressed. The various financing vehicles that are available to the governmental managers in a volatile international money market and the need to mesh project implementation to favorable financing schemes are also examined. Several methods of financing are discussed with some references to bond rating criteria. The

need for flexibility in all phases of project financing is stressed. (Author's abstract)
W88-04436

6B. Evaluation Process

MISSISSIPPI WATER RESOURCES CONFERENCE, 1986.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-159398/AS. Price codes: A05 in paper copy, A01 in microfiche. (1986). 98 p. Contract No. 14-08-0001-G1026. Project No. USGS G1026.

Descriptors: *Water management, *Data storage and retrieval, Water law, Computer models, Mathematical models, Model studies, Hydraulic models, Groundwater movement, Surface water, Economic impact, Waterways.

The proceedings of the sixteenth Mississippi water resources conference are compiled. In this conference, papers focused on specific problems, systems, and methods applicable to water management in the state and the region. Twenty-five papers by separate authors addressed information/data management, assessed economic impacts of water use and management, presented modeling techniques for various surface and groundwater problems, presented water quality studies, reviewed alternative sources of supply, and discussed impacts of Mississippi's water code. (Hawkins-Mississippi State University)
W88-03493

ISSUES IN HUMAN RISK ASSESSMENT,
Ecological Analysts, Inc., Sparks, MD.
H. Plugge.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1457-1468, 1 fig, 1 tab, 19 ref.

Descriptors: *Cost-benefit analysis, *Risks, *Public health, *Chlorination, *Regulations, Drinking water, Water treatment, Water pollution effects, Mutagens, Statistical analysis.

Risk assessment, a rapidly evolving science, has many deficiencies. Although quantitative methodologies for assessing air pollution exposure and chronic cancer hazards have been developed to a great extent, only primitive models exist for other areas, namely groundwater exposure potential. Interchemical interactions, sensitive population, and statistical considerations have been integrated sparingly into risk assessment, particularly in a quantitative manner. Many uncertainties exist in a cost-benefit analyses when incorporated into regulatory risk assessments. More acceptable risk estimates may be obtained with cost-effectiveness and related approaches. Risk assessment methodologies will be used increasingly in regulatory activities. Risk estimates must be presented as educated guesstimates with ranges of uncertainty. Regulation of water chlorination should not be based on single chemicals such as trihalomethanes or free chlorine but on multichemical, multimedia assessments. (Cassar-PTT)
W88-03556

COST-BENEFIT APPROACH TO DRINKING WATER AND CANCER,
California Inst. of Tech., Pasadena.
T. Page, and R. Harris.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 2: Environment, Health, and Risk, Ann Arbor Science, Ann Arbor, MI. 1983. p 1469-1479, 1 tab, 11 ref.

Descriptors: *Cost-benefit analysis, *Drinking water, *Chlorination, *Risks, *Cancer, Uncertainty, Water treatment, Regulations.

Formal cost-benefit analysis has been increasingly used in the evaluation of regulations before promulgation. A balanced cost-benefit approach attempts to estimate the potential costs of each kind of mistake and the probabilities of each type. It then attempts to minimize the expected cost of regulatory mistakes of either type. Applying this approach to drinking water shows that more attention has been given to analysis of statistical significance (probability of false positive) than to analysis of statistical power (probability of false negative). If the cost of a false negative (preventable but unprevented cancers) is higher than the cost of a false positive (unecessary water treatment), then uncertainty associated with the probability of a false negative is more pivotal than uncertainty associated with the probability of a false positive. This means that more attention should be focused on questions of statistical power and the minimum detectable effects. A balanced cost-benefit analysis considers uncertainties leading to probabilities of both false positives and false negatives. This means not relying on single, point estimates and treating them as though they were certain. Observing how later evidence confirms or refutes earlier predictions and comparing independent sources of evidence are useful. For drinking water the profile of uncertainty suggests that some degree of risk aversion is appropriate, meaning that it is desirable to take precautionary measures greater than indicated by straight, expected net benefit maximization alone. (Cassar-PTT)
W88-03557

PRACTICAL APPROACH TO WATER DISTRIBUTION SYSTEM MODELING,
Beta Engineering, Inc., Boston, MA.
For primary bibliographic entry see Field 5F.
W88-03617

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-185 054/AS. Price codes: A12 in paper copy, A01 in microfiche. USGS, OFSS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2250, 1984. 243 p, 26 fig, 9 tab.

Descriptors: *National water assessment, *United States, *State water issues, *Hydrologic events, Water availability, Water quality, Hydrologic hazards, Land use, Institutional arrangements, Water management.

This national summary reviews current hydrologic conditions and recent events in the United States and provides a broad overview of the hydrologic issues facing the Nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the western Pacific Islands under the jurisdiction of the United States. The State water-issue summaries were prepared by U.S. Geological Survey personnel in each of the States and are based on discussions with more than 130 State and local organizations. Taken together, these State summaries indicate the major similarities and differences in water issues facing different parts of the country. Major issues described include (1) the short-term vulnerability of surface water supplies and shallow groundwater supplies to drought; (2) concerns about the reliability of water levels as compensation for water increases; (3) declining groundwater levels; (4) control of surface water pollution, especially nonpoint sources of pollution; (5) contamination of groundwater supplies and the mitigation of existing sources of pollution, such as hazardous-waste sites; (6) the potential effects of acidic precipitation; (7) chronic problems of flooding; (8) the impacts of resource development, such as coal mining and low-head hydropower, on water resources; and (9) the development of water allocation and reallocation procedures. Hydrologic perspectives on these issues are discussed under the headings 'Water Availability'; 'Water Quality'; 'Hydrologic Hazards and Land Use'; and 'Institutional and Management'. (USGS)
W88-03911

SUMMARY OF EIGHTEENTH MEETING, INTERAGENCY ADVISORY COMMITTEE ON WATER DATA.
Geological Survey, Reston, VA. Water Resources Div.
OWDC Report. December 1984. 45 p, 7 app.

Descriptors: *Water data, *Networks, *National water resources research center, *National information clearinghouse, *Interagency cooperation, Information systems, Information exchange, Hydrologic forecasting, Water control, Indian water rights.

A summary is presented of the Eighteenth Meeting of the Interagency Advisory Committee on Water Data, held September 18-19, 1984, in Williamsburg, Virginia, under the auspices of the U. S. Geological Survey's Office of Water Data Coordination. Major topics of discussion at the meeting were the proposed Water Resources Research Center and Information Clearinghouse, special data needs of regulatory agencies, and integrating information systems for hydrologic forecasting and water control. Other topics covered at the meeting were the U.S. Geological Survey National Network and water data for Indian water rights determinations. (USGS)
W88-03943

METHODOLOGY TO DETERMINE CONSEQUENCES OF VARIATIONS IN WATER MANAGEMENT FOR AGRICULTURE,
Waterloopkundig Lab. te Delft (Netherlands).
G. Baarse, and E. Van Beek.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 25-44, 4 fig, 4 tab, 2 ref.

Descriptors: *Water policy, *Water management, *The Netherlands, *Models, *Irrigation efficiency, Evaluations, Management planning, Cost analysis, Model studies, Economic aspects, Cost-benefit analysis, Irrigation efficiency, Water costs.

Agriculture is the biggest user of water in the Netherlands according to the the PAWN (Policy Analysis for the Water Management of the Netherlands) study. The interrelations between agriculture and the water management systems are complicated and may be described by computer models that represent the three different levels of water management: user level, district level, and national level. A Water Distribution Model was developed to describe the water management system of the nation. The District Hydrologic and Agriculture Model (DISTAG) describes the water management system of the district. The Plot Models represent the role of water in agriculture. Three different plot models were developed: the Plot Water Model to simulate the water flows in the plot, the Plot Salt Model to simulate the salt flows in the plot, and the Plot Damage Cost Model to determine the loss of agricultural production and costs of sprinkling. The Distribution Model uses DISTAG as a subroutine, while DISTAG uses the Plot Models as subroutines. In addition, other models were utilized for sprinkling cost analysis, sprinkler operation analysis, and agriculture benefit analysis. These models were used in the different stages of the PAWN-analysis to compute costs, benefits and other impacts for many conceivable future situations and water management policies. The results confirmed the dominant role of agriculture, both with respect to water demand and impacts. (Geiger-PTT)
W88-03970

COST MINIMIZATION ANALYSIS OF THE FUTURE DRINKING WATER SUPPLY IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
P. K. Koster, and F. Langeweg.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 45-56, 3 fig, 2 tab, 1 ref.

Descriptors: *Drinking water, *Models, *Water policy, *Water supply, *Water costs, Cost analysis, Cost-benefit analysis, Future planning, Groundwater availability, Economic aspects, Water management, Model studies, Resource allocation, Project planning, Decision making.

The PAWN (Policy Analysis for the Water Management of the Netherlands) framework was used to develop a simple, linear programming model to analyze the production and transportation costs of the future drinking water supply in the Netherlands. The main variables in this analysis are the extractable quantities of groundwater, the priorities in allocating groundwater to different users and the future need for drinking water. Using these variables, several policy alternatives were derived from which decision-makers can choose the one they favor. A cost-minimal solution may be obtained for each policy alternative using the linear programming model. In the model, investment functions are used to determine the fixed and variable costs coefficients of different types of drinking water projects by applying the unity method, which involves calculating the average unit costs. New projects are allocated using the variable costs. The results of the analysis are presented in terms of the quantities of groundwater to be extracted as a trade-off function of groundwater vs. costs, since groundwater is considered to be the main source for drinking water supply. The present policy will be applied to the structure plan for the future drinking water and industrial water supply. (Geiger-PTT)
W88-03971

MINIMUM COST ALLOCATION OF GROUNDWATER TO DRINKING WATER COMPANIES AND INDUSTRIES,
Waterloopkundig Lab. te Delft (Netherlands).
P. J. A. Baan.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 57-68, 1 fig, 3 tab, 3 ref.

Descriptors: *Drinking water, *Models, *Water policy, *Water costs, *Groundwater availability, *Cost allocation, *Economic aspects, Cost analysis, Future planning, Water management, Model studies, Resource allocation, Project planning, Decision making, Water demand.

Groundwater is a valuable source of water in the Netherlands. In the past 20 yr, groundwater withdrawals have increased, causing decreases in the groundwater level. The demand for groundwater is expected to increase in the future. PAWN (Policy Analysis for the Water Management of the Netherlands) policies and measures were studied which would lead to a more rational use of groundwater. Models were developed to predict the responses of the various user groups (industry, drinking water companies, and agriculture) to groundwater policies and measures and to determine the impacts of these policies. This paper focuses on the responses of industry and drinking water companies. Industry can switch from groundwater to other sources (surface water, drinking water) or apply recirculation. Surface water projects can replace groundwater for drinking water production, however, it results in much higher drinking water prices. The costs for both industry and drinking water production increase substantially in cases of severe restrictions on groundwater use. The PAWN results suggest that agriculture should get priority for groundwater use over industry and drinking water companies. This conclusion, however, is sensitive to the increase in forecasted groundwater demand and the way the benefits to agriculture are estimated. (Geiger-PTT)
W88-03972

CONSEQUENCES FOR SHIPPING OF WATER-WITHDRAWALS FROM THE RIVER RHINE IN THE NETHERLANDS AND THE METHOD USED IN THE PAWN STUDY TO ESTIMATE THE FINANCIAL IMPLICATIONS,
Rijkswaterstaat, The Hague (Netherlands).
J. W. Pulles.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 69-78, 2 fig.

Descriptors: *Economic aspects, *Navigation, *Model studies, *Overdraft, *Water management, Cost analysis, Project Planning, Water costs, Models, Resource allocation, Dredging, Nonconsumptive use, Ships, Navigable rivers, Locks.

When relatively large quantities of water are withdrawn from the Rhine River in the Netherlands, the available water depths for shipping at the withdrawal points are reduced. This may cause problems for shipping under certain circumstances. In the PAWN (Policy Analysis for the Water Management of the Netherlands) study, the financial consequences of these water withdrawals have been studied using the Distribution Model. This model calculates the size of the withdrawals from the river at the locations Tiel and Eefde. The direct consequences of these withdrawals are obtained from the hydraulic relations between stream flow, rate of withdrawal and water depth. From these results and other calculations, the costs of the direct consequences resulting from the sedimentation process, two approaches were followed - the situation with dredging, and the situation without dredging. With the Distribution Model, the consequences for shipping of the various changes in the water management system were compared with the benefits gained by the other user groups. The consequences for shipping were calculated using 1976 prices. The higher costs for energy have not yet been taken into account. (Geiger-PTT)
W88-03973

RELATION BETWEEN WATER MANAGEMENT AND POWER PRODUCTION AND THE WAY ITS CONSEQUENCES ARE INVESTIGATED IN THE PAWN STUDY,
Rijkswaterstaat, The Hague (Netherlands).
J. W. Pulles.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 79-86, 1 fig.

Descriptors: *Models, *Economic aspects, *Water management, *Electric power production, *Thermal pollution, Cost analysis, Future planning, Water policy, Water costs, Model studies, Project planning, Water demand, Electric power demand, Electric powerplants, Environmental effects.

The consequences of power production in the Netherlands for water quality are discussed. To diminish the environmental effects of heat discharges by powerplants, standards are set. In the PAWN (Policy Analysis for the Water Management of the Netherlands) study, the financial consequences of these standards for powerplants are studied via a modelling approach. The Water Distribution Model was used to calculate the thermal linkage between the powerplants under certain assumptions. The Distribution Model passes a set of matrices on to the Electric Power Redistribution and Cost (EPRAC) Model. These matrices contain data on how each powerplant influences the other and how the heat crossing the border influences the water temperature at the various powerplant locations. With this data, the EPRAC Model determines how much heat still can be discharged into the various watercourses without exceeding the standard. The EPRAC Model is a linear programming optimization model that determines the optimal electrical production over the various available production units by the hour. The PAWN analysis showed that it was always possible to supply the national power demand for the large set of cases studied. Improvements in water management in the shipping and agriculture sectors had no important effects on the costs to the power companies. (Geiger-PTT)
W88-03974

MODEL DESCRIBING THE WATER DISTRIBUTION IN THE NETHERLANDS THE SCREENING OF WATER MANAGEMENT TACTICS,
Waterloopkundig Lab. te Delft (Netherlands).
G. Baarse, E. Van Beek, and J. P. M. Dijkman.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 87-106, 3 fig, 2 tab, 7 ref.

Descriptors: *Water management, *Project planning, *Models, *Economic aspects, *Cost analysis, Model studies, Water policy, Pricing, Simulation analysis, Water costs, Water use, Water distribution.

The Water Distribution Model (DM), which was developed in the PAWN (Policy Analysis for the Water Management of the Netherlands) study, simulates the operation of the national water management system of the Netherlands based on a network representation of links and nodes, taking into account a great many of the specific features of this complex system. The most important surface water user groups (agriculture, shipping, powerplants, and the environment) are directly considered in the DM. Separate models were developed to reflect the consequences of water management tactics for these user groups. The model results have been integrated in the DM to enable the calculation of the overall consequences of water management tactics in terms of cost and benefits to different users, and distribution and concentrations of a number of important pollutants. In screening, three different kinds of measures have been considered: screening of Pricing and Regulation tactics (PR-tactics); screening of waterboard plans; and screening of Technical and Management tactics (TM-tactics). This paper focuses on the screening of TM-tactics by simulating the effects of the tactics under various conditions using the DM. Promising tactics were selected for further analysis. Only a limited number of investigated TM-tactics were found to be promising. None of the larger projects that were suggested in the past were included in the list of promising tactics. (Geiger-PTT)
W88-03975

DESIGN OF POLICIES FOR THE WATER MANAGEMENT OF THE NETHERLANDS,
Waterloopkundig Lab. te Delft (Netherlands).
G. Baarse, and E. Van Beek.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 115-124, 2 fig, 6 ref.

Descriptors: *Water policy, *Water management, *Models, *Water allocation, *Management planning, Design criteria, Regulations, Project planning, Drinking water, Model studies, Pricing, Water use.

In the PAWN (Policy Analysis for the Water Management of the Netherlands) study, policy design is the stage that specifies alternative water management policies. A policy consists of a combination of four kinds of measures: technical, managerial, regulation, and pricing. Pricing and regulation measures prove to be promising tools to attain specific goals with respect to groundwater use. The Response Design Model (RESDM) was developed to predict the responses of industries and drinking water companies to pricing and regulation measures on groundwater withdrawals. To design effective managerial measures for the water management infrastructure, the Management Strategy Design Model (MSDM) was formulated. The results of the model studies indicate that there are few possibilities in the water management system in the Netherlands which allow optimization by managerial measures and that the optimal solution differs only marginally from the current operation practices. For extremely dry conditions, a priority list for the allocation of water among the various users and regions was developed. (Geiger-PTT)
W88-03977

ASSESSING IMPACTS OF WATER MANAGEMENT POLICIES,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 6A.
W88-03978

COST SHARING IN TRANSITION: THE CASE OF PLAN 6, CENTRAL ARIZONA PROJECT,
Bureau of Reclamation, Washington, DC.
For primary bibliographic entry see Field 6C.
W88-04274

PUBLIC PARTICIPATION IN WATERSHED MANAGEMENT: COMBINING NOMINAL GROUP PROCESS AND MICROCOMPUTERS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 6A.
W88-04292

ECONOMIC EFFICIENCY AND INVESTMENT TIMING FOR DUAL WATER SYSTEMS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
R. Leconte, T. C. Hughes, and R. Narayanan.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1807-1815, October 1987. 7 fig, 3 tab, 19 ref.

Descriptors: *Dual water systems, *Evaluation, *Economic aspects, *Water demand, *Model studies, *Water distribution, Mathematical models, Mathematical equations, Mathematical studies, Investment, Economic efficiency, Potable water, Nonpotable water, Feasibility studies, Financial feasibility, Costs.

A general method is presented for the evaluation of the economic feasibility of dual water systems which deliver both potable and nonpotable water to the same service area through separate distribution systems. In a first step, a static analysis (evaluation at a single point in time) is developed. The analysis requires the evaluation of consumers' and producers' surpluses from water use and the capital cost of the dual (outdoor) system. The analysis is then extended to a dynamic approach in which the water demand increases with time (as the result of a population increase) and in which the dual system is allowed to expand. The model determines whether construction of a dual system represents a net benefit, and if so, determines the best time to initiate the system (corresponding to maximization of social welfare). Conditions under which an analytic solution is possible are discussed and results of an application are summarized (including sensitivity to difficult parameters). The analysis allows identification of key parameters influencing attractiveness of dual water systems. (Wood-PTT)
W88-04300

IMPROVED ALGORITHMS FOR RESERVOIR CAPACITY CALCULATION INCORPORATING STORAGE-DEPENDENT LOSSES AND RELIABILITY NORM,
Indian Inst. of Science, Bangalore. Dept. of Computer Science and Automation.
For primary bibliographic entry see Field 2E.
W88-04302

RELIABILITY-BASED OPTIMIZATION MODEL FOR WATER DISTRIBUTION SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-04410

TEJO 1 - AN INTERACTIVE PROGRAM FOR THE DIVISION OF ESTUARIES INTO HOMOGENEOUS AREAS,
Universidade Nova de Lisboa (Portugal). Coll. of Sciences and Technology.
For primary bibliographic entry see Field 2L.
W88-04416

INTEGRATED WATER DEVELOPMENT PROJECT OF GRAVATAI RIVER BASIN, BRAZIL,
Departamento Nacional de Obras de Saneamento, Porto Alegre (Brazil).
R. Aoki.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 59-68, 1987. 3 fig, 3 tab, 1 ref.

Descriptors: *Water resources development, *Brazil, *Management planning, *Social aspects, *River basins, Geohydrology, Soil erosion, Land use, Economic aspects, Water supply, Industrial wastewater, Solid waste disposal, Hydrologic budget, Navigation, Conservation.

The integrated Water Resources Development Project of Gravatai River Basin was prepared by the National Drainage Works department and the German Agency for Technical Cooperation. An attempt was made to use the capacity available in other departments and specialized institutes to provide information for the departments involved in water resources management to enable them to establish specific terms for each hydrographic basin to complement the federal, state and municipal laws. The basin problems were considered as well as all aspects related to water resources development. With these suggestions the specialized department would be able to define their plans for the future taking into account factors that are not within their field of competence, but which should be taken into account in other fields of work. Conclusions include: (1) the project should treat approximately 150,000 w m/d of sewage produced by 730,000 inhabitants; (2) the project should treat approximately 40,000 cu m/d of industrial waste, with the installation of a system of automatic quality control of polluting effluents along the river; (3) small recycling units and composting plants should be implemented for the final disposal of solid wastes; (4) river water quality should be monitored at Passo do Vau; (5) a dam should be constructed at Passo do Vau, 5 m high, 200 m of concrete at the central portion and two earth embankments, with a total length of 500 m. This dam would maintain a minimum flow of 5 cu m/d; and (6) flood protection systems must be implemented in the towns of Alvorada and Cachoeirinha. (Geiger-PTT)
W88-04418

WATER RESOURCES PLANNING - A RESEARCH PROGRAM,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 6A.
W88-04424

DEVELOPMENT OF WATER QUALITY INDICES FOR OPERATIONAL MANAGEMENT,
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
For primary bibliographic entry see Field 5G.
W88-04427

INTEGRATED WATER RESOURCE MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN: OPPORTUNITIES AND CONSTRAINTS,
Comision Economica para America Latina, Santiago (Chile). Div. of Natural Resources and the Environment.
A. Dourogeanni, and M. Nelson.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 201-210, 1987. 2 tab, 12 ref.

Descriptors: *Water resources development, *Resources management, *Water management, *Developing countries, *Water policy, Economic aspects, Social aspects, Environmental impact statement, Water demand, Management planning, Irrigation, Flooding, Water law, Legal aspects.

The virtues of integrated water resource management have been widely extolled in the literature. This paper reviews selected aspects of the Latin American and Caribbean experience which may provide insights on the constraints and opportunities for progressing towards such integration. Economic development and population growth are placing demands on water which are increasing exponentially. However, with a few exceptions, governments have shown little effective response to the broader issues in resolving the inevitable conflicts. Formulation of plans and policies appears straightforward and it is easier still to recommend implementation by powerful co-ordinating agencies. However, practice bears little relation to theory. This suggests that a focus on questions other than technical optimization might be relevant. Attention needs to be given to the institutional structure - formal and informal rules - which determines why decisions are made at the political, organizational and operational levels, resulting in de facto water management. Greater transparency on the informal rules may enable more systematic transactions between and within these three levels (particularly within the organizational level) leading to changes which would allow incorporation of a broader and more long-term view of renewable resource management issues. (Author's abstract)
W88-04432

RIVER BASIN MANAGEMENT IN ENGLAND AND WALES,
Southern Water Authority, Worthing (England).
B. R. Thorpe.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 211-216, 1987. 7 ref.

Descriptors: *Water resources development, *Water policy, *England, *Wales, *Water management, Resources management, Rivers, Water law, Water supply, Water costs, Water quality, Sanitation, Hydrologic cycle, Local governments, Management planning, Water districts.

The concept of integrated river basin management in England and Wales came from the Working Party on Sewage Disposal in 1970. River basin management in England and Wales was instituted through the Water Act of 1973. This act set up ten regional water authorities (RWA's) as multipurpose bodies responsible for all water functions. The ten RWA's took over the functions and assets of over 150 water supply undertakings and over 1,300 sewerage and sewage disposal authorities. The RWA's have been successful in managing the water programs of England and Wales on an integrated basis. If metering of domestic water use becomes a reality in England and Wales, the charges will more closely reflect the costs imposed. Another initiative of the present Conservative government is to introduce proposals for transferring the RWA's to private ownership. It is recommended that, if this occurs, the principle of unified river basin management must be preserved. (Geiger-PTT)
W88-04433

EXPERIENCES IN WATER RESOURCES MANAGEMENT IN DEVELOPED REGIONS,
Ohio River Valley Water Sanitation Commission, Cincinnati.
L. Weaver, and P. A. Tennant.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 217-223, 1987. 15 ref.

Descriptors: *Water management, *Water resources development, *Water supply, *Water policy, *Water use, Economic aspects, Water pollution, Management planning, Irrigation, Transportation, Recreation, Hydroelectric power, Resources management, Social aspects, Political aspects.

The science and engineering of water resources in developed countries has undergone profound changes in less than a professional lifetime. This has radically influenced education and research and essentially revolutionized water resource planning. Fundamental uses of water to fulfill society's needs continue. These include domestic and industrial supplies, waterways for transportation, fire protection, waste carriage, recreation, irrigation, and in general, an adequate quantity and quality of water in the right place at the right time to fulfill human and aquatic needs. The complexities of water resources no longer may be measured largely in terms of science and engineering challenges alone, but must include economics sensitive to the political and social sciences. What has evolved is now best described as water management. Reviewed here is the evolution of water resources management in developed countries in terms of

historical background, and national policies and institutions, particularly as this evolvement impacts scientific research and engineering application. (Author's abstract)
W88-04434

OASIS SYSTEMS MANAGEMENT,
Economic Center, Water Legislation and Administration, Mendoza (Argentina).
For primary bibliographic entry see Field 6A.
W88-04435

SOCIO-ECONOMIC DEVELOPMENT LEVEL AND TECHNOLOGY POLICIES FOR WATER RESOURCES MANAGEMENT,
Departamento Nacional de Aguas e Energia Eletrica, Brasilia (Brazil). Div. de Controle de Recursos Hidricos.
G. Tsuzuki.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 273-276, 1987.

Descriptors: *Water management, *Water resources development, *Economic aspects, *Water policy, *Brazil, *Data acquisition, Management planning, Water use, Resources management, Water quality control, Water quality management, Institutions.

Water is considered to be essential for all forms of life. The multiple uses of water and the consequences of its inadequate use, as well as the socio-economic conflicts arising from the inappropriate management of water resources, are discussed. The impact of the marked differences in development between the regions which result from the large size of Brazil must be taken into account. Policy decisions regarding the management of water basins will determine the form of participation of the different sectors in water resources use with priority given to human uses for direct consumption and hygiene, and to uses of the soil associated with floods. A variety of methods may be used for data collection, analysis, interpretation and storage. These methods range from manual equipment to large main frame computers. The purpose of the creation of a National System for Water Resources Management is to organize and institutionalize, whenever necessary, a dynamic and efficient system for the adequate management of water resources. (Author's abstract)
W88-04439

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

IRRIGATION EFFICIENCY: ECONOMIC INTERPRETATION,
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
G. D. Lynne, K. Anaman, and C. F. Kiker.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 317-334, August 1987. 2 fig, 3 tab, 30 ref.

Descriptors: *Irrigation efficiency, *Economic aspects, *Water demand, *Water yield, Water supply, Costs, Revenues, Risk, Water management.

To clarify the nature of irrigation efficiency, economic efficiency is defined and its relation to technical efficiency examined. Yield efficiency in water demand and cost efficiency in water supply are both necessary for technical efficiency but are not sufficient conditions for maximizing profits. Maximizing the utility from income while accounting for risk is another form of economic efficiency and may be more descriptive of managers who are risk-averse. (Author's abstract)
W88-03783

POLICY ANALYSIS FOR THE NATIONAL WATER MANAGEMENT OF THE NETHERLANDS.
Commissie voor Hydrologisch Onderzoek TNO, The Hague (Netherlands).
Background Papers for the Technical Meeting 39, June 1982. 144 p.

Descriptors: *Water policy, *Water management, *Water supply, *The Netherlands, *Models, Water distribution, Evaluations, Management planning, Cost analysis, Model studies, Drinking water, Pricing, Economic aspects, Water costs.

A major study of the water management of the Netherlands entitled PAWN (Policy Analysis for the Water Management of the Netherlands) was conducted during the years 1977 and 1979. After a description of the water-system of the Netherlands, the problems that initiated the study are dealt with and the various stages of the stages of the analysis and the features of the models used are explained in some detail. The study covers the following topics: a methodology to determine consequences of variations in water management for agriculture; a cost minimization analysis of the future drinking water supply in the Netherlands; minimum cost allocation of groundwater to drinking water companies and industries; consequences for shipping of water-withdrawals from the river Rhine in the Netherlands and the method used in the PAWN study to estimate the financial implications; the relation between water management and power production and the way its consequences are investigated in the PAWN study; a model describing the water distribution in the Netherlands and the screening of water management tactics; screening of pricing and regulation measures for water allocation in the PAWN study; design of policies for the water management of the Netherlands; and assessing impacts of water management policies. (Geiger-PTT)
W88-03968

METHODOLOGY TO DETERMINE CONSEQUENCES OF VARIATIONS IN WATER MANAGEMENT FOR AGRICULTURE,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03970

COST MINIMIZATION ANALYSIS OF THE FUTURE DRINKING WATER SUPPLY IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03971

MINIMUM COST ALLOCATION OF GROUNDWATER TO DRINKING WATER COMPANIES AND INDUSTRIES,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03972

CONSEQUENCES FOR SHIPPING OF WATER-WITHDRAWALS FROM THE RIVER RHINE IN THE NETHERLANDS AND THE METHOD USED IN THE PAWN STUDY TO ESTIMATE THE FINANCIAL IMPLICATIONS,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03973

SCREENING OF PRICING AND REGULATION MEASURES FOR WATER ALLOCATION IN THE PAWN STUDY,
Rijkswaterstaat, The Hague (Netherlands).
W. A. Dorsman.
IN: Policy Analysis for the National Water Management of the Netherlands, Background Papers for the Technical Meeting 39, June 1982. p 107-114, 1 ref.

Descriptors: *Pricing, *Economic aspects, *Water costs, *Water allocation, *Regulations, Water management, Project planning, Water policy, Water use, Cost allocation, Resource allocation.

This paper explains how in the PAWN (Policy Analysis for the Water Management of the Netherlands) study the list of many potential pricing and regulation measures for the reallocation of water resources was reduced to manageable size, containing only measures that were to be studies further. Criteria for selection were feasibility, significance of the measures' benefits for at least one user group, cost-effectiveness, economic efficiency, and dominance by other measures. Pricing and regulation measures for controlling water allocation have to be specific on the source of the water (groundwater, drinking water, or surface water), water users that will be affected, the area the users are in, and the type of control measures to be taken. The type of policy instruments needs to be specified (water pricing schemes) as well as whether the policy is a permanent or temporary measure. Although no specific policy instruments for pricing and regulation were made in the PAWN study, some important observations were given. Putting a fixed price on each unit of water may help allocate the units to those within a user group who value the water most. Control on the amounts of water withdrawn are valid for the long run (year round), while for a short period (1-2 wk), controlling the exact withdrawals requires a lot of administration. (Geiger-PTT)
W88-03976

EVALUATION OF UNCERTAINTY IN FLOOD MAGNITUDE ESTIMATOR ON ANNUAL EXPECTED DAMAGE COSTS OF HYDRAULIC STRUCTURES,
Wyoming Univ., Laramie. Water Resources Research Inst.
Y. Bao, Y. K. Tung, and V. R. Hasfurther.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2023-2029, November 1987. 6 fig, 1 tab, 9 ref.

Descriptors: *Flood damage, *Costs, *Cost-benefit analysis, *Hydraulic structures, Economic aspects, Evaluation, Flood frequency, Culverts, Damage, Model studies.

In the risk-based design for hydraulic structures, the major task is the evaluation of the annual expected damage costs caused by floods. Due to the use of a limited amount of data in flood frequency analysis, the computed flood magnitude of a specified return period is subject to uncertainty. A methodology to integrate such uncertainty in the evaluation of annual expected flood damage was developed and is illustrated through an example in culvert design. The effect of uncertainty in estimating flood magnitude using different hydrologic probability models with different sample sizes on the annual expected damage cost is examined. Results of the study show that the effect of the uncertainty in a flood magnitude estimate on annual expected damage is quite significant and is sensitive to the sample sizes and the probability distribution models used. (Author's abstract)
W88-04179

COST SHARING IN TRANSITION: THE CASE OF PLAN 6, CENTRAL ARIZONA PROJECT,
Bureau of Reclamation, Washington, DC.
K. G. Maxey, and N. H. Starler.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 749-759, October 1987. 5 tab, 20 ref.

Descriptors: *Water management, *Cost sharing, *Economic aspects, *Financing, *Central Arizona Project, Resources management, Costs, Federal cost sharing, Construction costs, Arizona, Resources development, Financial feasibility, Negotiations.

In the past, development of Federal water resource projects depended heavily or exclusively on Federal financing of construction costs. However, pressures on the Federal budget, environmental issues, and the notion that there are economic efficiency gains when beneficiaries of Federal water resource projects increase their cost share are causing changes. The case of the Central Arizona Project Plan 6 is a noteworthy example of the transition to more non-Federal participation in water resource development. This is because the non-Federal financing is to be provided for a project already under construction. The negotiations and terms of the Plan 6 financing agreement between the Department of the Interior and multiple interests in Arizona are used as an example of how Federal

water project cost sharing is in a state of transition. The negotiation process is described, a financial analysis is provided, and the terms of the agreement and policy issues that were deliberated in the Executive Branch of the Federal Government are discussed. (Author's abstract)
W88-04274

RIVER BASIN MANAGEMENT IN ENGLAND AND WALES,
Southern Water Authority, Worthing (England).
For primary bibliographic entry see Field 6B.
W88-04433

INNOVATIVE FINANCING TECHNIQUES IN A VOLATILE MARKET REQUIRE COOPERATIVE EFFORT,
Gulf Coast Waste Disposal Authority, Houston, TX.
For primary bibliographic entry see Field 6A.
W88-04436

6D. Water Demand

TAKING WATER TO MARKET,
For primary bibliographic entry see Field 6E.
W88-03605

REDUCING WATER PUMPING POWER COSTS,
Waxahachie, TX.
For primary bibliographic entry see Field 5F.
W88-03612

PRACTICAL APPROACH TO WATER DISTRIBUTION SYSTEM MODELING,
Beta Engineering, Inc., Boston, MA.
For primary bibliographic entry see Field 5F.
W88-03617

WATER FOR AGRICULTURE,
Agricor, Mafeking (South Africa).
P. G. Pienaar.
Aqua AQUAAA, No. 3, p 133-136, 1987. 3 tab, 7 ref.

Descriptors: *Agricultural water demand, *Planning, *Water resources, *Water demand, *Bophuthatswana, *South Africa, Irrigation requirements, Eutrophication, Surface water, Groundwater.

The changing pattern of water use in Southern Africa is reviewed. Because of the population growth, water demand for non-agricultural usage has increased. As a result, agricultural use of water is under scrutiny. The restricted water resources in Bophuthatswana and the projected primary demand in the year 2010 are examined to establish the potential for agricultural use. It is estimated that of the total available water of 333.29 million cu m/yr, there will be a surplus of 34.49 million cu m/yr. available for agricultural use, which is approximately the amount needed for current irrigation schemes. Eutrophication and evaporation affect the quality of the available water. It is concluded that future planning should be carried out with more circumvision than ever before, and that no single sector can operate in isolation of the other sectors competing for water. Water development plans must incompass a regional scheme and be based on a national water management strategy. (Ray-PTT)
W88-03678

USE OF PUBLIC RESOURCES FOR WATER SUPPLY AND SANITATION PROJECTS IN DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC.
For primary bibliographic entry see Field 5F.
W88-03679

FIELD STUDY INTO PATTERNS OF DOMESTIC WATER CONSUMPTION IN RURAL AREAS OF BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Civil Engineering.
F. Ahmed, and P. G. Smith.
Aqua AQUAAA, No. 3, p 149-153, 1987. 2 fig, 5 tab, 1 ref.

Descriptors: *Water demand, *Water use, *Wells, *Domestic water, *Rural areas, *Bangladesh, *Tubewells, Socio-economic status, Sanitary facilities, Drinking water, Potable water, Well water.

Results of a field study of the patterns of water consumption in rural areas of Bangladesh indicate that most drinking water is taken from tubewells, but that unprotected sources such as rivers and ponds are often used for other domestic purposes. The reasons for the non-usage of tubewell water are: Traditional habit, distance from the source, time spent in collecting water and its use, poor water quality, lack of proper washing and bathing facility at tubewell site and lack of privacy. An average of 40 liters per capita per day consumption of water may be considered normal under rural living conditions. (Ray-PTT)
W88-03681

EXTENDED LOW FLOW PERFORMANCE - WHAT'S IT REALLY WORTH,
Rockwell International, Pittsburgh, PA.
For primary bibliographic entry see Field 5F.
W88-03682

RELATION BETWEEN WATER MANAGEMENT AND POWER PRODUCTION AND THE WAY ITS CONSEQUENCES ARE INVESTIGATED IN THE PAWN STUDY,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03974

WATER CONSUMPTION AND DEMAND MEASUREMENTS FOR SINGLE-FAMILY HOUSEHOLDS,
Hawaii Univ., Honolulu. School of Public Health.
F. D. Miller.
Journal of Environmental Health JEVHAH, Vol. 50, No. 1, p 13-17, July-August, 1987. 5 tab, 13 ref.

Descriptors: *Water use, *Surveys, *Water demand, *Drinking water, Water supply, Consumptive use, Potable water, Sampling, Statistical analysis.

A simplified economical survey method identifies and measures predictors of residential water supply demand (the total amount of water used by a household) and household water and fluid consumption (the amount of tap water and fluid drinks consumed by individual household members). A telephone survey of Kaimuki residents of Oahu, Hawaii was conducted to determine households that were willing to fill out a questionnaire. Data from completed questionnaires was analyzed by according to demographic characteristics, household characteristics, water demand, consumption of water and fluids for drinking, and other variables. Results showed ethnic differences for both water supply demand and consumption. The addition of high sodium table condiments was associated with increased fluid intake. The number of people in each household was the main determinant of water consumption. Other important predictors of water supply demand in Kaimuki were shower and toilet use, and number of laundry loads. The proportion of the total fluid intake that was consumed as water, either from the tap or chilled tap water, was only about 12%. (Geiger-PTT)
W88-04092

CONNECTICUT'S WATER SUPPLY PLANS,
Connecticut Dept. of Health Services, Hartford. Water Supply Section.
For primary bibliographic entry see Field 5F.
W88-04159

ESTIMATING THE WATER RESOURCE FOR A HIGH SIERRA WATERSHED,
New Jersey Hazardous Waste Facilities Siting Commission, Trenton.
W. G. Guthe, and M. L. Shelton.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 767-775, October 1987. 3 fig, 2 tab, 31 ref.

Descriptors: *Water yield, *Water resources, *Estimating, *Runoff, *Available water, *Watershed management, *Model studies, Watersheds, Mathematical equations, Sierra Nevada, Runoff volume, Hydrologic budget, Data interpretation, Stream discharge, Groundwater, Groundwater recharge, Hydrologic models.

Competition for water, concerns for maintaining groundwater quality, and compliance with legislative action require quantification of the water resource for high elevation watersheds in the Sierra Nevada. However, meager hydroclimatic data frequently hinder runoff assessments needed for formulating water development policies, and the selection of watershed models for estimating the water resource is limited to those requiring a minimum of observational data. A climatic water budget model and an energy slope and aspect model are employed to estimate the water resource for a small watershed in Sierra Valley north of Lake Tahoe. The models employ different assumptions and computational procedures, but the total water available estimated by both models is very similar. Measured runoff is estimated satisfactorily by the models, but streamflow is not representative of the total water resource because a substantial portion of the available water enters the regional groundwater system. This conclusion is supported by hydrologic and geochemical evidence, and groundwater recharge is estimated to be at least as great as measured runoff during dry years and nearly twice as large during wet years. (Author's abstract)
W88-04276

ECONOMIC EFFICIENCY AND INVESTMENT TIMING FOR DUAL WATER SYSTEMS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6B.
W88-04300

RELIABILITY-BASED OPTIMIZATION MODEL FOR WATER DISTRIBUTION SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-04410

6E. Water Law and Institutions

MISSISSIPPI WATER RESOURCES CONFERENCE, 1986.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-03493

DRINKING WATER PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W88-03552

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART III-OXYGEN, MOISTURE, ORDOR, PATHOGENS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W88-03596

TAKING WATER TO MARKET,
R. T. Smith, and R. J. Vaughan.
Civil Engineering CEWRA9, Vol. 57, No. 3, p 70-73, March 1987.

Descriptors: *Water management, *Water use efficiency, *Western United States, *Economic aspects, *Water rights, *Water resources development, *Planning, *Water demand, Deserts, Irrigation, Farms, Legal aspects, Water scarcity.

Water marketing of western water resources is proposed as a means to allow those owning water rights and those needing water to negotiate transfers of water voluntarily. Two cases of water trading in Arizona have occurred. The Department of Interior has recently created an Office of Water Marketing, California has enacted legislation to promote water markets, and many western states are considering similar legislation. The Western Governors' Policy Office endorses trade in water as the best solution to water problems, and calls for state/federal cooperation to remove impediments to water marketing. Despite their advantage, water markets have not developed quickly. The potential gains to water users and to those helping create the water markets are enormous. (Main-PTT)
W88-03605

LEGAL THEORIES AND DAMAGES EMPLOYED IN GROUNDWATER POLLUTION LITIGATION,
Day, Berry and Howard, Hartford, CT.
D. M. Cordiano.
Journal NEWWA JNEWA6, Vol. 101, No. 1, p 9-21, March 1987.

Descriptors: *Groundwater pollution, *Legal aspects, *Environmental protection, *Environmental policy, *Legislation, *Liability, *Laws, *Drinking water, *Water pollution control, Water pollution effects, Environmental quality, Legislation, Laws, Drinking water, Water pollution effects, Hazardous materials, Seepage, Public policy, Pollutants, Water pollution sources.

The number of legal theories in groundwater pollution litigation and their variety are surprising. Under the common law, federal statutes, and state statutes there are numerous ways that liability is imposed for actions that are both intentional and unintentional. An outline of the main legal theories of liability which are encountered in groundwater pollution litigation are provided. Damages available as a result of groundwater pollution litigation are as numerous as the theories behind these suits. Cleanup and restoration costs are potentially the most serious and are available in any suit. The only exception is statutes which regulate discharges almost exclusively, such as the Clean Water Act. In the context of costs associated with litigation, which can be apportioned by the court, consulting fees or treatment studies may often fall on the polluter. (Main-PTT)
W88-03613

PREPARATION AND TRIAL OF A GROUNDWATER CONTAMINATION CASE,
Day, Berry and Howard, Hartford, CT.
For primary bibliographic entry see Field 5G.
W88-03614

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W88-03911

STATE WATER QUALITY PLANNING ISSUES: FINAL REPORT.
Council of State Governments, Lexington, KY.
For primary bibliographic entry see Field 5G.
W88-03939

POLICY ANALYSIS FOR THE NATIONAL WATER MANAGEMENT OF THE NETHERLANDS.
Commissie voor Hydrologisch Onderzoek TNO, The Hague (Netherlands).
For primary bibliographic entry see Field 6C.
W88-03968

GENERAL ASPECTS OF THE POLICY ANALYSIS FOR THE WATER MANAGEMENT OF THE NETHERLANDS (PAWN),
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 6A.
W88-03969

CONTROL OF POLLUTANTS IN WASTE WATER,
Environmental Protection Agency, Washington, DC. Industrial Technology Div.
For primary bibliographic entry see Field 5G.
W88-04002

TESTING FOR GROUNDWATER CONTAMINATION AT HAZARDOUS WASTE SITES,
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5A.
W88-04003

HEALTH SERVICES AND WATER AND SANITATION SERVICES IN THE NORTHWEST TERRITORIES: AN EXAMINATION OF THE PRESENT STATE OF DEVELOPMENT AND SOME THOUGHTS FOR THE FUTURE,
Izaak Walton Killam Hospital for Children, Halifax (Nova Scotia).
For primary bibliographic entry see Field 5F.
W88-04077

WHAT'S HAPPENING WITH WATER: INDUSTRY DIRECTION - LOOKING TO THE FUTURE,
Becher-Hoppe Engineers, Inc., Wausau, WI.
For primary bibliographic entry see Field 5F.
W88-04162

L.A.'S WASTEWATER TREATMENT PLANT: VICTIM OR VILLAIN,
For primary bibliographic entry see Field 5D.
W88-04194

FLOW VARIABLE DISCHARGE PERMITS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-04275

NEW HAMPSHIRE WATER LAW: AN INTERPRETIVE OVERVIEW,
Larson (Barry) Associates, Concord, MA.
C. M. Kingsford, and B. E. Lindsay.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 845-848, October 1987. 16 ref. Land and Water Competing Uses for Economic Development in New Hampshire Project H-294.

Descriptors: *Water law, *Water allocation, *Riparian rights, *New Hampshire, *Legal aspects, *Water use, Resource allocation, Water rights, Water demand, Water management, Water policy, Public rights, Competing use.

New Hampshire's riparian water law, first modified judicially, was more drastically changed by recent legislative and administrative action. As it stands, however, the judicially enforced doctrine of reasonable use appears to be utterly inadequate to handle increasing water demands. The protection of the public interest has imposed substantial limitations on the use of riparian water rights, all under the guise of the exercise of police power, i.e., the protection of the public health, safety, and welfare. The efficient use of the state's water resources has been further crippled by the widespread and indiscriminate use of eminent domain. As a result, the state is now considering the imposition of a permit system that has the potential to streamline the allocation of water. Such a system should take into consideration the public interest factors that have recently frustrated the exercise of riparian rights and the effective use of the state's water resources. (Author's abstract)
W88-04285

INTERSTATE AND INTERNATIONAL COMPETITION FOR WATER RESOURCES,
Hawaii Univ. at Hilo. Dept. of Political Science.
Z. A. Smith.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 873-877, October 1987. 1 fig, 18 ref.

Descriptors: *Interstate water management, *International water management, *Groundwater management, *Legal aspects, Water resources development, Competing use, Federal juriadiction, Groundwater, Judicial decisions, Regulations, State jurisdiction, Water law.

Federal-state relations over the management and regulation of groundwater resources have undergone a number of changes in recent years. There are a variety of reasons that the role of the federal government in groundwater management may increase in the future. One important reason federal policymakers may become involved concerns the extent of competition for groundwater resources that cross state and national borders. The reasons that interstate and international competition for groundwater resources may provide the impetus for federal intervention in groundwater management are summarized and the results of a survey conducted to determine the extent of that competition are presented. The major U.S. Supreme Court decisions laying the foundation for federal authority over groundwater use were reviewed; they were based on either the reservation doctrine for water originating on federal lands or the commerce clause of the U.S. Constitution. A discussion of the disadvantages of federal intervention in groundwater management is included and the suggestion that short-term sacrifices on the parts of local and state water policymakers may be preferable to the long-term consequences of federal intervention is given. (Wood-PTT)
W88-04290

SALINITY CONTROL OF INTERSTATE WATERS IN ARGENTINA,
Instituto Nacional de Ciencia y Tecnica Hidricas, Mendoza (Argentina).
For primary bibliographic entry see Field 5G.
W88-04367

WATER RESOURCES IN DEVELOPING COUNTRIES,
Departamento de Aguas e Energia Eletrica, Sao Paulo (Brazil).
For primary bibliographic entry see Field 6G.
W88-04431

INTEGRATED WATER RESOURCE MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN: OPPORTUNITIES AND CONSTRAINTS,
Comision Economica para America Latina, Santiago (Chile). Div. of Natural Resources and the Environment.
For primary bibliographic entry see Field 6B.
W88-04432

SOCIO-ECONOMIC DEVELOPMENT LEVELS AND ADEQUATE REGULATORY POLICY FOR WATER QUALITY MANAGEMENT,
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
For primary bibliographic entry see Field 5G.
W88-04438

SOCIO-ECONOMIC DEVELOPMENT LEVEL AND TECHNOLOGY POLICIES FOR WATER RESOURCES MANAGEMENT,
Departamento Nacional de Aguas e Energia Eletrica, Brasilia (Brazil). Div. de Controle de Recursos Hidricos.
For primary bibliographic entry see Field 6B.
W88-04439

6F. Nonstructural Alternatives

INITIATIVE FOR RISK-BASED FLOOD DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. R. Dawdy, and D. P. Lettenmaier.
Journal of Hydraulic Engineering JHENDS, Vol. 113, No. 8, p 1041-1051, August 1987. 35 ref.

Descriptors: *Flood flow, *Risks, *Management planning, *Flood plain zoning, *Flood routing, Hydraulic structures, Spillways.

A recent report of the Interagency Advisory Committee on Water Data found that there is 'no current procedure for assigning an exceedance probability to the probable maximum flood (PMF)...in a reliable, consistent or credible manner.' This conclusion was used as justification for continuation of the current, quasi-deterministic, PMF-based spillway design methods used by all federal agencies. This is despite criticism by both researchers and practitioners that PMF-based methods tend to lead to a false sense of security and to misallocation of resources for dam safety improvements. As an alternative to perpetuation of the status quo, four general areas in which research should be promoted for improved estimation of extreme floods are outlined, well as research aimed at development of a method for incorporation of risk information into a spillway design. If the federal action agencies were to promote research in the areas suggested, the current stagnation that has set in would be broken, and the self-fulfilling prophecy that there are no alternatives to current practice could no longer be justified. (Author's abstract)
W88-04398

6G. Ecologic Impact Of Water Development

UTILIZING CABLE TV TO YOUR PR ADVANTAGE,
Wannacomet Water Co., Nantucket, MA.
D. D. Worth.
Journal NEWWA JNEWA6, Vol. 101, No. 1, p 62-65, March 1987.

Descriptors: *Environmental issues, *Cable TV, *Public relations, *Economic aspects, *Public participation, *Public lands, *Environmental policy, *Education, Benefits, Attitudes, Recreation, Shellfish, Hazardous materials.

Use of local cable television stations can provide an efficient and economical means to deliver information on environmental issues. In this manner, environmental awareness can be generated as well as good public relations for the local TV station. Examples used in Nantucket, Massachusetts included hazardous waste disposal, beach and dune erosion, wetland conservation, shellfish harvesting and management, beach environment awareness, and percolation test education. (Main-PTT)
W88-03616

MULTIVARIATE APPROACH TO THE INVESTIGATION OF NUTRIENT INTERACTIONS IN THE BARATARIA BASIN, LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5C.
W88-03936

RELATION BETWEEN WATER MANAGEMENT AND POWER PRODUCTION AND THE WAY ITS CONSEQUENCES ARE INVESTIGATED IN THE PAWN STUDY,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 6B.
W88-03974

EVALUATION OF THE STEEL CREEK ECOSYSTEM IN RELATION TO THE PROPOSED RESTART OF THE L-REACTOR: INTERIM REPORT,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W88-03989

COMMUNITY RESOURCE MANAGEMENT IN A TROPICAL WATERSHED - A CASE STUDY,
For primary bibliographic entry see Field 2H.
W88-04176

REVISED ESTIMATES OF POWER PLANT ENTRAINMENT OF ICHTHYOPLANKTON IN WESTERN LAKE ERIE IN 1975-77,
Michigan Univ., Ann Arbor. School of Natural Resources.
R. L. Patterson.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 1, p 78-83, 1987. 4 tab, 1 ref.

Descriptors: *Entrainment, *Lake Erie, *Ichthyoplankton, *Powerplants, Larvae, Mathematical studies, Fish populations.

Previous estimates of larval production and power plant entrainment, distributed over four power plants, were revised using a lumped parameter method by which power plant mortality is estimated independently of natural mortality. Using the method, mean daily power plant entrainment of four species of ichthyoplankton averaged over three seasons of production (1975-77) ranged from zero to 7.6%. These estimates are statistically consistent with earlier estimates made by a more laborious, distributed parameter technique. Estimates of seasonal production may differ substantially due to methodological differences in the estimation of the daily abundance curves. If entrainment estimates from individual power plants are not required, the lumped parameter method is recommended over the distributed parameter technique. (Lantz-PTT)
W88-04210

INFLUENCE OF KIELDER WATER ON TRICHOPTERAN (CADDISFLY) POPULATIONS IN THE RIVER NORTH TYNE (NORTHERN ENGLAND),
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
P. J. Boon.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 95-109, April-June 1987. 6 fig, 5 tab, 50 ref. British Ecological Society Small Project Grant No. 269.

Descriptors: *Kielder Dam, *Ecological effects, *Caddisfly, *Population density, *North Tyne River, England, Water temperature, Water resources development, Reservoirs, Population density, River flow.

Impounding the North Tyne has reduced the frequency of high peak flows, eliminated periods of extremely low flow and modified the temperature regime downstream from the Kielder Dam. The results of a recent survey of North Tyne trichopteran populations (Hydropsychidae, Rhyacophilidae, and Polycentropodidae) were compared with those from previously published work in order to assess the impact of river regulation. Benthic samples were collected monthly upstream and downstream from the reservoir. Although nine out of the ten species found previously were also collected in the post-impoundment survey, species diversity was reduced downstream from the dam. This was mainly the result of disproportionate increases in Hydropsyche siltalai population densities which were up to 9.6 times greater than before; flow regulation and its effect on substrate stability may be largely responsible for this. Rhyacophila dorsalis also increased in abundance downstream probably in response to the altered flow regime. In contrast Hydropsyche pellucidula constituted a smaller proportion in downstream samples with population densities in places only a fifth of pre-impoundment levels. The differential effect of regulation on these two hydropsychid species may be explained by their different flow velocity preferences. Upstream from the reservoir, standing crops were frequently lower than before possibly due to the disruption of colonization cycles. Growth rates of H. siltalai, H. pellucidula, and R. dorsalis below the dam were accelerated at certain times of the year and retarded at others, apparently correlated with the winter-warm, summer-cool discharges from the reservoir. Since this study was completed Kielder Water has begun generating hydroelectricity, and the flow regime downstream has consequently changed to one of regular, daily fluctuations. It is suggested that any adverse effects of this on the benthic community are likely to be offset by the continued benefit of eliminating flash floods with high peak flows. (Author's abstract)
W88-04225

STREAM REGULATION IN ARGENTINA, INCLUDING THE SUPERIOR PARANA AND PARAGUAY RIVERS,
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina).
A. A. Bonetto, H. P. Castello, and I. R. Wais.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 129-143, April-June, 1987. 4 fig, 2 tab, 52 ref.

Descriptors: *Surface flow, *Regulated flow, *Dams, *Ecological effects, Water resources development, Paraguay, Argentina, Limnology, Reservoirs, Water temperature, Thermal pollution, Aquatic environment.

Argentine water resources are located in three hydrologically contrasting regions: the so-called Del Plata basin, the Arid Central Andean area, and Patagonia. About 150 dams and impounding reservoirs that exceed a capacity of 150,000 cu m, have been built. Most limnological studies of regulated rivers have been conducted recently. In the Del Plata basin, Argentine dams are scarce, although many have been built or are projected upstream, mainly in Brazil. The ecological problems of the reservoirs are related to decomposition of inundated terrestrial vegetational algae blooms, dissolved oxygen depletion phenomena, eutrophication, impaired fish migrations, overproduction of water hyacinth Eichhornia spp., and schistosomiasis. The importance of examining the influence of the projected middle Parana dams on downstream sediment regimes, especially as it affects the delta, is emphasized. In the Arid or Central Andean region, the main development of the Grande-Tercero rivers includes dams, reservoirs, and the operation of a nuclear power plant. One of the most important effects will be a slight increase in the water temperature of the Rio Tercero reservoir as a consequence of water use in the cooling system of the nuclear power plant. In the Patagonian region, the main dams are those built and projected for the Colorado and Negro basins. In the Negro basin studies are being carried out mainly in the Ramos Mexia Reservoir, on different aspects of zooplankton and phytoplankton, benthos, and fishes. Commercial fishing is not permitted and fishing is based mainly on the introduced salmonids which show symptoms of undernourishment because of a lack of forage fishes. Indigenous fishes have been decimated by the introduced salmonids. Although studies have been conducted in several areas, much work remains to be done in relation to the environmental effects of dams on streams in Argentina. Results from the ecological studies are still insufficient to solve the multiple problems associated with them, such as climatic influences retention of suspended solids, deforestation, schistosomiasis and other aquatic diseases, pollution, eutrophication, etc. (Author's abstract)
W88-04227

ECOLOGICAL EFFECTS OF GROUNDWATER PUMPING AND A NATURAL DROUGHT ON THE UPPER REACHES OF A CHALK STREAM,
Freshwater Biological Association, Wareham (England). River Lab.
J. F. Wright, and A. D. Berrie.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 145-160, April-June, 1987. 6 fig, 2 tab, 32 ref.

Descriptors: *Groundwater mining, *Drought, *Water resources development, *Ecological effects, Groundwater management, Discharge, Invertebrates, Fish, Macrophytes, Streamflow.

The ecological effects of a three-month test of a groundwater pumping scheme, which augmented flow in a chalk stream were examined in autumn 1975. The impact on the macrophytes and invertebrates in the upper perennial stream which received pumped water were minimal. After pumping ceased, a dry winter and spring led to a major drought in summer 1976. This prompted operational use of the groundwater pumping scheme in late summer 1976 prior to heavy winter rains which resulted in a return to the normal pattern of discharge in 1977. The ecological effects of the drought, the operational pumping and its aftermath were assessed on three channel reaches: the intermittent zone of the stream, which remained dry throughout 1976; the upper perennial channel where changes in flow regime were most severe; and the lower perennial section of the stream. Drying of the intermittent section for over one year had more severe effects on the invertebrates and fish populations than on the macrophytes, which recovered rapidly after the return of flow. In the upper perennial section, the drought led to siltation of the river-bed, loss of macrophytes and limited habitat diversity for the invertebrate fauna. Further downstream, effects were still detectable, thought less severe. Operational pumping brought immediate benefit to the perennial stream by increasing the river width, removing silt and encouraging growth of macrophytes, which provided habitat and food resources for invertebrates. However, in the upper perennial reach, where siltation and loss of macrophytes had been severe, regrowth of macrophytes was slow and the effects of the drought on both macrophytes and invertebrates were still apparent in autumn 1977. It is proposed that a pumping policy that maintains river flow above the level at which siltation and subsequent loss of macrophytes occurs could minimize undesirable ecological effects of extreme low flows. (Author's abstract)
W88-04228

EFFECTS OF TRANSFERRING GLACIER-FED WATER TO A CLEAR-WATER MOUNTAIN RIVER ON THE PRODUCTION AND FOOD ORGANISMS OF BROWN TROUT (SALMO TRUTTA L.) IN SOUTHERN NORWAY,

Direktoratet for Vilt og Ferskvannsfisk, Aas (Norway). Fish Research Div.
T. Hesthagen, and A. Fjellheim.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 2, p 161-170, April-June, 1987. 3 fig, 5 tab, 44 ref.

Descriptors: *Glacial streams, *Rivers, *Ecological effects, *Trout, *Norway, *Water transfer, Fish load, Fish populations, Growth.

The effects of transferring glacier-fed water to a clear-water river on production and food organisms of brown trout (Salmo trutta L.) were investigated in a mountain river, in southern Norway. Production in unregulated fluvial habitat was 271.5 g/100 sq m/yr compared with 103.1 g/100 sq m/yr in a glacier-fed reach of the river. This difference was due to low fish density and recruitment rate. The growth rate, at least for younger fish (2+ to 4+ age groups), was significantly higher in the regulated reach of the river. The main difference in food composition was the low abundance of crustaceans Eurycercus lamellatus and Gammarus lacustris in the regulated reach. Trichopterans were the main diet component in both sites. (Author's abstract)
W88-04229

SCALE EFFECTS IN FLUVIAL SEDIMENT-ASSOCIATED CHEMICAL DATA,

National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 2J.
W88-04242

WATER QUALITY AND DIATOM COMMUNITIES IN TWO CATALAN RIVERS (N.E. SPAIN),

Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5C.
W88-04252

HYPOLIMNETIC WITHDRAWAL IN TWO NORTH AMERICAN LAKES WITH ANOXIC PHOSPHORUS RELEASE FROM THE SEDIMENT,

York Univ., Downsview (Ontario). Faculty of Science.
For primary bibliographic entry see Field 5G.
W88-04254

EFFECTS OF IRRIGATION ON WATER QUALITY OF A SHALLOW UNCONFINED AQUIFER,

Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
M. E. Close.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 793-802, October 1987. 6 fig, 4 tab, 16 ref.

Descriptors: *Irrigation effects, *Path of pollutants, *Groundwater quality, *Aquifers, Water quality, Water pollution effects, Irrigation, Strip irrigation, Wells, Correlation analysis, Nitrates, New Zealand, Water table, Sodium, Sulfates, Calcium, Bicarbonates, Potassium, Chlorides, Groundwater recharge.

The groundwater quality of a shallow unconfined aquifer was monitored before and after implementation of a border strip irrigation scheme, by taking monthly samples from an array of 13 shallow wells. Two 30 m deep wells were sampled to obtain vertical concentration profiles. Marked vertical, temporal, and spatial variabilities were recorded. The monthly data were analyzed for step and linear trends using nonparametric tests that were adjusted for the effects of serial correlation. Average nitrate concentrations increased in the preirrigation period and decreased after irrigation began. This was attributed to wetter years in 1978-1979 than in 1976-1977 which increased leaching, and to disturbance of the topsoil during land contouring before irrigation, followed by excessive drainage after irrigation. Few significant trends were recorded for other determinants, possibly because of shorter data records. Nitrate, sulfate, and potassium concentrations decreased with depth, whereas sodium, calcium, bicarbonate and chloride concentrations increased. These trends allowed an estimation to be made of the depth of groundwater affected by percolating drainage. This depth increased during the irrigation season and after periods of winter recharge. Furthermore, an overall increase in the depth of drainage-affected groundwater occurred with time, which paralleled the development of the irrigation scheme. (Author's abstract)
W88-04279

POLLUTION AND EUTROPHICATION IN THE VENICE LAGOON,

Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
R. Cossu, E. De Fraja Frangipane, D. Degobbis, A. A. Orio, and G. Andreottola.
Water Science and Technology WSTED4, Vol. 19, Nos. 5/6, p 813-822, 1987. 6 fig, 1 tab, 15 ref.

Descriptors: *Eutrophication, *Venice Lagoon, *Water quality, Monitoring, Hydrogen ion concentration, Water temperature, Salinity, Dissolved oxygen, Ammonia, Nitrogen, Zinc, Coliforms, Algae, Nutrients.

To reduce the effect of the 'high water', which involves mainly the City of Venice, a project is underway to install barriers in the three port channels which connect the Venice lagoon to the Northern Adriatic Sea. To have a basis on which to gauge any observed effects in the water quality as a consequence of the reduction of the exchange of water between the lagoon and the open sea, a survey on the most polluted area of the lagoon was carried out over the period of a year. The following parameters were determined: pH, temperature, salinity, transparency, dissolved oxygen, ammoniacal nitrogen, orthophosphate, zinc and total coliforms. The results, compared to those obtained from previous studies, show that the situation has improved for ammoniacal nitrogen, zinc and coliforms and remained fairly constant for the other parameters. The inner zones of the lagoon are much more exposed to eutrophication as a consequence of a lower circulation of water and higher accumulation of nutrients. Release from sediments appears to play an important role in controlling the water quality in the shallow areas. Frequent algae blooms have been observed during spring and summer seasons. There is no evidence of an attenuation of eutrophic phenomena in recent years. (Author's abstract)
W88-04365

HABITAT ELEMENTS IN RIVER BASIN MANAGEMENT AND PLANNING,

Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-04414

INSTITUTIONS AND MANAGING THE ENVIRONMENT,

Universidade Federal de Santa Catarina. Florianopolis (Brazil). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W88-04417

DAMS AND THE ENVIRONMENT,

Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and technoplogy WSTEDH4, Vol. 19, No. 9, p 69-80, 1987. 6 fig, 5 tab, 15 ref.

Descriptors: *Dam effects, *Environmental impact statement, *Environmental effects, *Water resources development, *Reservoirs, Design criteria, Recreation, Project planning, Aeration, Lake sediments, Ecological effects, Water quality, Legal aspects, Dam design, Dam construction.

The environmental impact of dam and reservoir construction in the Federal Republic of Germany is examined. Uses of reservoirs in densely populated regions include water supply, low flow augmentation, flood control, navigation, and recreation. Detailed regulations for dams and reservoirs are established in the state water laws and in the administration performance laws. The effects of the dam on the surrounding environment should be investigated carefully before construction. Use of the reservoir for recreation requires monies for upkeep, litter removal, and safety considerations. Aeration devices may be required in deep impoundments to prevent eutrophication. Sediment removal was required in Lake Baldeney to maintain a water depth of at least 2.3 meters. Construction of a reservoir in a densely populated region takes about 20 years. Engineers must evaluate all competing aspects of a project to see it become a reality. (Geiger-PTT)
W88-04419

TOWARDS CONTROL OF AN ESTUARY,

Ministry of Transport and Public Works, The Hague (Netherlands).
For primary bibliographic entry see Field 2L.
W88-04428

WATER RESOURCES IN DEVELOPING COUNTRIES,

Departamento de Aguas e Energia Eletrica, Sao Paulo (Brazil).
W. S. Casadei.
Water Science and technology WSTEDH4, Vol. 19, No. 9, p 195 200, 1987.

Descriptors: *Brazil, *Developing countries, *Water resources development, *Water policy, *Environmental impact statement, Water supply, Water demand, Water law, Economic aspects, Models, Public participation, Resources management, Public health, Environmental effects.

Improving the standard of living in developing countries is closely related to water resource development and management. The quality and reliability of water supplies normally found in developed countries will probably have to be lowered, on a temporary basis, to be adapted to the socio-economic realities of each country. Most developing countries do not have a national policy for water resources management, lacking even a water supply policy. Many existing water models are not adequately scaled to the situations in developing countries. The economic problems faced by developing coutnries are more serious and complex than those faced by the advanced nations. Much of the effort to raise living standards in the developing countries involves deliberately modifying the natural environment. The construction of roads, dams, airports, irrigation and sewerage systems, power plants, and industrial facilities fequently results in ecological problems. The water resources policy of Brazil, and especially of the State of Sao Paulo, has been characterized by investment in single-purpose works, mainly for hydro-electric power. Many of these projects are carried out by the Water and Electrical Power Department (DAEE). DAEE is establishing a planning process to permit adequate water resources management in each of its seven Watershed Divisions. DAEE has sought to formulate a Water Resources National Policy that would encompass the following points: the State should be able to make supplementary laws regarding water management; environmental protection items must be included in the Constitution; the use of water resources must be carried out in a multiple and integrated way; basic sanitation should be dealt with as a matter of public health; and the public should be able to participate in government decision concerning the use of water resources. (Geiger-PTT)
W88-04431

EXPERIENCES IN WATER RESOURCES MANAGEMENT IN DEVELOPED REGIONS,
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 6B.
W88-04434

OASIS SYSTEMS MANAGEMENT,
Economic Center, Water Legislation and Administration, Mendoza (Argentina).
For primary bibliographic entry see Field 6A.
W88-04435

CHARACTERISTICS OF SESTON IN A REGULATED APPALACHIAN MOUNTAIN RIVER, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-04473

CHANGES IN THE RIFFLE MACROINVERTEBRATE FAUNA OF THE TANJIL RIVER, SOUTHEASTERN AUSTRALIA, DURING CONSTRUCTION OF BLUE ROCK DAM,
Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman, D. P. Robinson, and K. G. Hortle.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 4, p 317-329, December 1987. 2 fig, 5 tab, 39 ref.

Descriptors: *Macroinvertebrates, *Tanjil River, *Australia, *Dam construction, *Blue Rock Dam, Ecological effects, Statistical analysis, Sedimentation, Erosion control, Species diversity, Population density.

Macroinvertebrates were sampled from riffles upstream and downstream of the Blue Rock Dam construction site and inundation area in late November/early December 1979 (before construction) and 1982 (late in construction). Changes in the downstream fauna were much less than at some other large dam sites in Australia, probably because of improved erosion control. At the downstream sampling stations the total number of taxa collected was similar in both years, but there was a 30-40% reduction in faunal density; no significant change in density occurred at the upstream station. Multivariate analysis showed that the degree of change in faunal composition between years was similar at upstream and downstream stations. The proportion of fine (<4mm) inorganic sediment in the streambed increased significantly at downstream stations over the study period, while there was no significant change upstream. Silt (<250 micrometers) also increased significantly downstream, but never exceeded 1% of inorganic bed material. (Author's abstract)
W88-04475

WATER DEVELOPMENT AND ASSOCIATED HYDROLOGIC CHANGES IN THE PLATTE RIVER, NEBRASKA, U.S.A.,
Denver Univ., CO. Dept. of Geology and Geography.
R. F. Hadley, M. R. Karlinger, A. W. Burns, and T. R. Eschner.
Regulated Rivers: Research and Management RRRMEP, Vol. 1, No. 4, p 331-341, December 1987. 13 fig, 16 ref.

Descriptors: *Water resources development, *Ecological effects, *Platte River, *Nebraska, Channel morphology, Streamflow, Sediment transport.

Major changes in hydrologic regime and morphology of channels of the Platte River and its major tributaries, the South Platte River and North Platte River in Colorado, Wyoming, and Nebraska have occurred since about 1860, when the water resources of the basin began to be developed for agriculture, municipal, and industrial uses. The extent of this water development, which continues to increase with growth in population and land use, has affected the timing of streamflow and transport of fluvial sediment in the Platte River through diversions, reservoirs storage, and increased use of groundwater. Changes in flow regime, such as increase in low-flow magnitudes and abatement of peak-flow magnitudes, have made the riverine environment conducive to vegetative growth while reducing channel scour. These factors, in turn, contribute to morphologic changes of decreased channel width and channel area and increased island formation. (Author's abstract)
W88-04476

7. RESOURCES DATA

7A. Network Design

CIRRUS-CLOUD EXPERIMENT: INTENSIVE FIELD OBSERVATIONS PLANNED FOR FIRE,
State Univ. of New York at Albany.
For primary bibliographic entry see Field 2B.
W88-03647

STATISTICAL ANALYSIS OF INDUSTRIAL WASTEWATER MONITORING DATA,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, P. S. Porter, and G. Settembre.
Journal Water Pollution Control Federation JWPFA5, Vol. 59, No. 3, p 145-151, March 1987. 7 fig, 1 tab, 19 ref.

Descriptors: *Statistical analysis, *Data monitoring, *Regulatory compliance, *Water pollution control, *Water quality management, *Industrial wastewater treatment, *Computers, *Network design, Data acquisition.

For many industrial wastewater treatment operations, the long-term management goal of regulatory compliance is supported by a water quality monitoring program. A network-design study of IBM's wastewater treatment East Fishkill Facility in Hopewell Junction, NY. involved 5 major components: (1) Review of monitoring goals and objectives (2) Evaluation of background data statistical characteristics (3) Specification of the monitoring network physical configuration (location, variables and frequencies for monitoring) (4) Specification of routine data analysis procedures (5) Computerization of data storage, retrieval, analysis, and information reporting procedures. The monitoring program was viewed from the beginning as a total system so that information reported by the procedures developed in step 5 is adequate to satisfy the objective in step 1. An IBM PC/XT with 512K RAM and 10 megabyte internal hard disk with a monitor, 120 column printer, 4-color pen plotter, and 20 megabyte removal cartridge disk system for expended hard drive storage and back up capability was used. Although thesystem design was not perfect and many problems of both technical and institutional nature were not solved the bottom line results of the case study were judged to be positive. More information will be obtained from this plant and the overall cost of monitoring will be reduced. (Ray-PTT)
W88-03831

HYDROLOGIC MODELS OF SURFACE MINED AREAS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
A. R. Rao.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183182/AS. Price codes: A03 in paper copy, A01 in microfiche. Indiana Water Resources Research Center Technical Completion Report 155, West Lafayette. March 1983. 36 p, 10 fig, 46 ref. Project No. OWRT A-064-IND (1).

Descriptors: *Hydrologic models, *Model studies, *Strip mines, *Coal mining, Indiana, Rainfall-runoff relationships, Runoff, Surface runoff, Data collections, Water quality, ANSWERS model, KINGEN model, Overton-Meadows model, ANAWAT model, CREAMS USDAHL model, Grayman model, Infiltration.

A review of the literature on hydrology of surface mined areas reveals some problems related to data collection and to model development. The major problems in data collection arise from a lack of understanding of the hydrology of surface mined areas. Even in undisturbed watersheds parameters vary widely. In surface mined areas the variation is considerably larger. Soil moisture and infiltration must be monitored properly. Another problem is the representation of parameters so that they are of maximum use in models. Of the many available models, few have been tested with field data. Although the interaction between field measurements, proper representation of field data, and types of models used in surface mining hydrology is clear, these aspects have been treated separately thus far. The main conclusion is that, because of the variability in the hydrologic properties in these surface mined areas and the changes in these over time, the data acquisition and modeling of surface mined areas should be considered together for optimal solutions of problems related to both. (Cassar-PTT)
W88-03941

SUMMARY OF EIGHTEENTH MEETING, INTERAGENCY ADVISORY COMMITTEE ON WATER DATA.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W88-03943

SPACE-TIME STOCHASTIC MODEL OF RAINFALL FOR SATELLITE REMOTE-SENSING STUDIES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W88-04105

OPTIMIZATION OF REGIONAL WATER QUALITY MONITORING STRATEGIES,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 5G.
W88-04357

ROLE AND PROBLEMS OF MONITORING BOTTOM SEDIMENT FOR POLLUTION ASSESSMENT IN THE COASTAL MARINE ENVIRONMENT,
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W88-04362

ANALYSIS OF THE U. S. GEOLOGICAL SURVEY STREAMGAGING NETWORK,
Geological Survey, Reston, VA.
A. G. Scott.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 31-42, 1987. 6 fig, 12 ref.

Descriptors: *Stream gages, *Networks, *Hydrologic models, *Satellite technology, *Cost analysis, Error analysis, Geological surveys, Telemetry, Surface water, Water quality, Monitoring, Regression analysis, Hydrologic data collections, Flow measurement.

Results from the first 3 years of a 5-year cost-effectiveness study of the U. S. Geological Survey streamgaging network are reviewed. The study aims to define and document the most cost-effective means of furnishing streamflow information. In the first step of this study, data uses were identified for 3,493 continuous-record stations currently being operated in 32 states. In the second step, evaluation of alternative methods of providing streamflow information, flow-routing models, and regression models were developed for estimating daily flows at 251 stations of the 3,493 stations analyzed. In the third step of the analysis, relationships were developed between the accuracy of the streamflow records and the operating budget. The weighted standard error for all stations, with current operating procedures, was 19.9%. By altering field activities, as determined by the analyses, this could be reduced to 17.8%. The existing streamgaging networks in four Districts were further analyzed to determine the impact that satellite telemetry would have on the cost effectiveness. Satellite telemetry was not found to be cost effective on the basis of hydrologic data collection alone, given present cost of equipment and operation. (Author's abstract)
W88-04415

USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN RIVER BASIN MANAGEMENT,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and D. Forrest.
Water Science and Technology WSTEDH4, Vol. 19, No. 9, p 81-86, 1987. 2 fig, 9 ref.

Descriptors: *Information systems, *Geographic information systems, *River basins, *Graphical methods, *Resources management, *Hydrologic data collections, *Geography, Data interpretation, Spatial distribution, Temporal distribution, Computer models, Management planning, Project planning, Water resources development, Data storage and retrieval.

Geographic Information Systems (GIS) are shown to provide a number of capabilities which are of particular use to river basin operation and planning. GIS systems have the ability to display and graphically summarize both the input data for the analytical models and the results of application of management models using that data. The graphical display of input data can assist the interpretation of conditions within the basin through depiction of spatial and temporal patterns in that data. GIS can also reduce the time required to enter data, and improve the reliability of that data by reducing the errors in the data. The ability to display the results graphically improves the man-machine interaction which is generally accepted as being an integral part of multi-objective water resources analysis. Another important role for GIS is its use as an efficient interface between the data base and the operational computer models. It is asserted, however, that GIS should not be considered a means of providing final answers to complex water resources planning issues. It should be seen, rather, as an important component of Decision Support systems by which information on the basin issues is transferred to the decision maker for his consideration. Specific aspects of the application of GIS are discussed in relation to a hypothetical river basin system used primarily for hydroelectric energy generation. (Author's abstract)
W88-04420

7B. Data Acquisition

HIGH WATER DEMAND PRESSURE MONITORING,
For primary bibliographic entry see Field 5F.
W88-03600

ELECTRONICS EASES MANAGEMENT OF WASTEWATER COLLECTION SYSTEM,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W88-03602

FLUORESCENCE DETERMINATION OF TRACE AMOUNTS OF URANIUM(VI) IN VARIOUS MATERIALS BY A REPETITIVE LASER TECHNIQUE,
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
For primary bibliographic entry see Field 5A.
W88-03611

WEATHER RADAR AND WEATHER RADAR PROCESSING SYSTEMS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
P. Von Zweck, F. Loo, and A. H. Halff.
Public Works PUWOAH, Vol. 118, No. 4, p 66-67, April 1987. 1 tab.

Descriptors: *Remote sensing, *Weather radar, *Weather data collections, *Weather forecasting, *Radar, *Data processing, *Flood forecasting, *Hydrologic models, *Meteorological data collection, Floods, Precipitation, Computers.

Weather radar, a widely used tool for storm-monitoring and short-term forecasting, is becoming a useful tool in real-time flood forecasting models. The application of real-time weather radar data has the potential to revolutionize flood-control forecasting. The addition of radar estimated rainfall rates to flood forecasting systems that incorporate rain gage and stream gage measurements can significantly improve their forecasting abilities. National systems of radar and rain gage networks are economically feasible. (Main-PTT)
W88-03635

STUDY OF COPPER (II) COMPLEX COMPOUNDS WITH BISMUTHIOL DERIVATIVES IN BUTANONE,
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 5A.
W88-03638

CIRRUS-CLOUD EXPERIMENT: INTENSIVE FIELD OBSERVATIONS PLANNED FOR FIRE,
State Univ. of New York at Albany.
For primary bibliographic entry see Field 2B.
W88-03647

EFFECT OF LINEAR ALKYL BENZENE SULFONATE IN SKIN OF FISH FINGERLINGS (CIRRHINA MRIGALA): OBSERVATIONS WITH SCANNING ELECTRON MICROSCOPE,
Industrial Toxicology Research Centre, Lucknow (India).
For primary bibliographic entry see Field 5C.
W88-03665

ULTRASONIC FLOW MEASUREMENT IN PIPES AND CHANNELS,
Rittmeyer A.G., Zug (Switzerland).
R. Jenny, J. Ramm, and H. Jedelhauser.
Aqua AQUAAA, No. 3, p 157-162, 1987. 12 fig, 2 tab, 3 ref.

Descriptors: *Measuring instruments, *Water metering, *Flow measurement, *Ultrasonic flow-measurement, Water supplies, Water conveyance, Water treatment facilities, Hydroelectric power stations, Wastewater facilities.

Ultrasonic measuring systems have been successfully applied in the following sectors: (1) water supply, measuring the flow of raw and drinking water through pipes: (2) hydroelectric power stations measuring the flow of water through pipes and channels; (3) sewage treatments plants, measuring the flow of sewage through both pipes and channels; and (4) district-heating systems, measuring the flow of hot water through pipes. A minimun steadying length equal to ten times the pipe diameter is required upstream of measuring point to achieve a guaranteed accuracy of 1% for the pipe measurements. Reliable triggerable signals are essential for precise electronic timing in ultrasonic measuring systems. For measuring sewage and hot water, automatic trigger level tracking is essential since major fluctuations of the incoming signal are a common occurrence with such flows. Ultrasonic clamp-on transducers have the advantage of easy cost-savings installation on pressure pipes but the disadvantage of working with refracted beams. Ultrasonic flow measurement in channels is considerably more complicated than in pressure pipes and is used mainly in special cases where the known measuring techniques, such as those employing the Venturi flume or measuring weir, are unsuitable for hydraulic reasons. However, ultrasonic measuring devices can be used in power station and irrigation channels with defined profile contours up to widths of 10 m and in sewage systems and sewage disposal plants for channels having a width of up to 6 m. (Peters-PTT)
W88-03683

GROUND WATER QUALITY MONITORING: THE ARKANSAS APPROACH,
Arkansas Dept. of Pollution Control and Ecology, Little Rock.
R. Desmarais.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 3, p 69-73, Summer 1987. 2 fig, 1 tab, 4 ref.

Descriptors: *Groundwater quality, *Groundwater, *Monitoring, *Arkansas, *Water quality, *Networks, Geology, Literature searches, Data bases.

Monitoring groundwater quality on a statewide basis is a challenge being faced by a number of state and federal agencies involved with water quality. Many of these agencies have come forth with publications that are of some use to those who are engaged in developing monitoring networks. A review of this literature could save those involved much time and money by providing insight into what can be accomplished and/or avoided. Ultimately, each monitoring system has to be designed to meet the purposes and conditions for which it is created, no two situations ever being exactly alike. However, there are approaches and methods that can be borrowed and profitably utilized where both the problems confronted and the geology in which they are found are similar. It was the attempt to resolve these two conflicting tenets, situational uniqueness and methodological transferability, that impelled the state of Arkansas to develop the prototype approach that is described, along with some of the more important documents that were of use in the development of that approach. (Author's abstract)
W88-03757

WIRELINE PISTON CORE BARREL FOR SAMPLING COHESIONLESS SAND AND GRAVEL BELOW THE WATER TABLE,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
M. M. Zapico, S. Vales, and J. A. Cherry.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 3, p 74-82, Summer 1987. 5 fig, 10 ref.

Descriptors: *Coring drilling, *Core sampling, *Coring devices, *Sampling devices, *Measuring instruments, *Wireline piston core barrel, *Sand, *Gravel, *Water table, Drilling, Soil cores, Sediments, Field tests, Aquifers.

A coring device has been developed to obtain long and minimally disturbed samples of saturated cohesionless sand and gravel. The coring device, which includes a wireline and piston, was developed specifically for use during hollow-stem auger drilling but it also offers possibilities for cable tool and rotary drilling. The core barrel consists of an inner liner made of inexpensive aluminum or plastic tubing, a piston for core recovery, and an exterior steel housing that protects the liner when the core barrel is driven into the aquifer. The core barrel, which is approximately 1.6 m (5.6 feet) long, is advanced ahead of the lead auger by hammering at the surface on drill rods that are attached to the core barrel. After the sampler has been driven 1.5 m (5 feet), the drill rods are detached and wireline is used to hoist the core barrel, with the sample contained in the aluminum or plastic liner, to the surface. A vacuum developed by the piston during the coring operation provides good recovery of both the sediment and aquifer fluids contained in the sediment. In the field the sample tubes can be easily split along their length for on-site inspection or they can be capped with the pore water fluids inside and transported to the laboratory. The cores are 5 cm (2 inches) in diameter by 1.5 m (5 feet) long. Core acquisition to depths of 35 m (115 feet), with a recovery greater than 90 percent, has become routine in University of Waterloo aquifer studies. A large diameter (12.7 cm (5 inch)) version has also been used successfully. Nearly continuous sample sequences from sand and gravel aquifers have been obtained for studies of sedimentology, hydraulic conductivity, hydrogeochemistry and microbiology. (Author's abstract)
W88-03758

MULTIPLE-PACKER/STANDPIPE SYSTEM FOR GROUND WATER MONITORING IN CONSOLIDATED MEDIA,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
S. J. Welch, and D. R. Lee.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 3, p 83-87, Summer 1987. 6 fig, 7 ref.

Descriptors: *Piezometers, *Piezometric head, *Measuring instruments, *Monitoring, *Groundwater, *Packers, *Standpipes, Water analysis, Monitoring wells, Boreholes, Field tests.

A simple system of packers and plastic standpipes has been used for sampling water and monitoring piezometric levels at four to six selected points in 2.98 inches (76 mm) bedrock boreholes for up to five years. The relatively inexpensive packers held a required inflation pressure for at least four months and could be removed from the borehole when desired. The approach used is adaptable for other purposes and has been used for borehole dilution tests and vertical tracer tests. (Author's abstract)
W88-03759

SOIL GAS CONTAMINANT INVESTIGATIONS: A DYNAMIC APPROACH,
Tracer Research Corp., Tucson, AZ.
G. M. Thompson, and D. L. Martin.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 3, p 88-93, Summer 1987. 5 fig, 3 tab, 10 ref.

Descriptors: *Soil gas, *Path of pollutants, *Groundwater pollution, *Volatile organic compounds, Drilling, Sampling, Groundwater, Pollutants, Monitoring wells, Water pollution sources, Costs.

Soil gas contaminant mapping can save costs in a subsurface investigation by providing a rapid means of detecting and delineating VOC distributions in groundwater. Standard drilling and sampling methods are designed for monitoring purposes and are not optimal for searching. Potentially, more data can be collected regarding contaminant distribution at a site in one day from a soil gas investigation than in several days from conventional drilling and sampling techniques. Soil gas sampling becomes even cost-effective relative to conventional methods as the depth to water increases because the cost of well construction increases while the cost of soil gas sampling remains relatively constant. Results of a soil gas investigation are most often used to optimize the placement of monitoring wells or to more precisely define an area designated for remedial action. Another major application of the soil gas technology is locating contaminant source areas. The fact that numerous samples can be cost-effectively collected over a large area increases the probability of detecting contaminant sources within the boundaries of a plume. (Alexander-PTT)
W88-03760

SIMPLE LABORATORY MEASUREMENT OF UNSATURATED HYDRAULIC CONDUCTIVITY,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
For primary bibliographic entry see Field 2G.
W88-03789

CIRCULAR GATES IN CIRCULAR AND U-SHAPED CHANNELS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W88-03790

CONTRACTION RATIOS FOR WEIR AND FLUME DESIGNS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 8B.
W88-03791

PRECIPITATION DISCRIMINATION FROM SATELLITE INFRARED TEMPERATURES OVER THE CCOPE MESONET REGION,
Research and Data Systems, Inc., Lanham-Seabrook, MD.
For primary bibliographic entry see Field 2B.
W88-03808

APPLICATIONS OF IC IN ENVIRONMENTAL ANALYSIS,
For primary bibliographic entry see Field 5A.
W88-03819

APPLICATION OF ROBOTICS TO SAMPLE PREPARATION FOR ICP ANALYSIS,
For primary bibliographic entry see Field 5A.
W88-03820

FLOW INJECTION SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM IN NATURAL WATER USING ERIOCHROME CYANINE R AND CATIONIC SURFACTANTS,
Norsk Inst. for Skogforskning, Aas.
For primary bibliographic entry see Field 5A.
W88-03823

QUANTITATION OF TOXAPHENE IN ENVIRONMENTAL SAMPLES USING NEGATIVE ION CHEMICAL IONIZATION MASS SPECTROMETRY,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5A.
W88-03824

MICROWAVE DIGESTION TECHNIQUES IN THE SEQUENTIAL EXTRACTION OF CALCIUM, IRON, CHROMIUM, MANGANESE, LEAD AND ZINC IN SEDIMENTS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-03825

METHOD FOR DETERMINATION OF OXYGEN-18 OF HYDROGEN PEROXIDE IN RAINWATER,
Argonne National Lab., IL. Chemical Technology Div.
For primary bibliographic entry see Field 5A.
W88-03826

DETERMINATION OF ORGANIC COMPOUNDS LEACHED FROM MUNICIPAL INCINERATOR FLY ASH BY WATER AT DIFFERENT PH LEVELS,
Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 5B.
W88-03827

ISOLATION OF NONVOLATILE ORGANIC SOLUTES FROM NATURAL WATERS BY ZEOTROPHIC DISTILLATION OF WATER FROM N,N-DIMETHYLFORMAMIDE,
Geological Survey, Denver, CO.
J. A. Leenheer, P. A. Brown, and E. A. Stiles.
Analytical Chemistry ANCHAM, Vol. 59, No. 9, p 1313-1319, May 1, 1987. 8 fig, 4 tab, 26 ref.

Descriptors: *Organic matter, *Chemical analyses, *Organic solutes, *Nonvolatile organic solutes, *Dissolved organic carbon, *Zeotrophic distillation, *Natural Waters, Water quality, Organic solutes.

Nonvolatile, hydrophillic, organic solutes usually comprise 30% to 50% of the dissolved organic carbon in natural waters and they are difficult to isolate for study because of problems in separating these solutes from various salts dissolved in water. A procedure to isolate these nonvolatile, hydrophillic organic solute from natural saline waters consists of zeotrophic distillation of water from a mixture of water samples from a N,N-dimethylformamide-formic acid-acetonitrile mixture, removal of the sodium salts of inorganic acids by crystallization, removal of silicic acid by acidification and precipitation, boric acid by methylation and volatilization, and removal of phosphate by zinc acetate precipitation. Chemical alteration of the organic solutes was minimized by careful control of acid concentrations in the solvent mixtures and conversion of the samples to pyridinium and sodium salts. Recoveries of various hydrophillic organic standards from aqueous salt solutions and recoveries of natural organic solutes from various water samples varied from 60% - 100%. Losses of organic solutes during the isolation procedure were nonselective and related to the number of salt- and precipitate -washing cycles in the procedure. (Ray-PTT)
W88-03835

RELATIONS BETWEEN REMOTELY SENSED CANOPY TEMPERATURE, CROP WATER STRESS, AIR VAPOR PRESSURE DEFICIT AND EVAPOTRANSPIRATION IN CHICKPEA,
Space Application Centre, Ahmedabad (India).
For primary bibliographic entry see Field 2D.
W88-03872

METHODS TO EXPERIMENTALLY CONTROL WATERLOGGING AND MEASURE SOIL OXYGEN IN FIELD TRIALS,
Western Australia Dept. of Agriculture, South Perth.
For primary bibliographic entry see Field 2G.
W88-03880

ELECTROMAGNETIC METHOD FOR DELINEATING GROUNDWATER CONTAMINATION, WOOD RIVER JUNCTION, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-03887

ICE VOLUMES ON CASCADE VOLCANOES: MOUNT RAINER, MOUNT HOOD, THREE SISTERS, MOUNT SHASTA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W88-03894

FLUID-DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN. Water Resources Div.
J. V. Skinner, and J. P. Beverage.
U. S. Corps of Engineers, St. Paul, Report X, A Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams, 1982. 125 p, 25 fig, 36 tab, 9 ref.

Descriptors: *Suspended-sediment concentration, *Density cell, U-tube, Steady-state solids concentration, Calibration, Error compensation, Vibration, Electronic feedback circuit, Electronic timing circuit.

A fluid-density gage for measuring suspended-sediment concentration consists of a commercial vibrating U-tube liquid-density cell coupled to a special feedback and digital period-measurement circuit. For steady concentrations of inorganic fluvial-sediment with a nominal density of 2.65 grams/cu cm, the random measurement-error increases with an increase in particle size. For clay concentrations that exceed 500 mg/L, the standard error of estimate is less than 3% of the indicated concentration; for coarse sand, the error is 12%. For concentrations less than 500 mg/L, random errors are nearly independent of concentration. In this low-concentration range the random error is 15 mg/L for clay and 25 mg/L for sand. Because a systematic shift in response occurs with a change in particle size, the gage will require field calibration. The sensitivity to dissolved solids is nearly equal to the sensitivity to inorganic sediments. The gage can be compensated for dissolved solids and temperature. Tests with plastic beads chosen to simulate the density of organic detritus indicate the gage's sensitivity to this material is desirably low. During unsteady conditions, the instrument requires approximately 9 minutes to adjust to a step-change in liquid temperature, but only 5 seconds to adjust to a step-change in fluid density. (USGS)
W88-03926

APPLICATION OF PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY TO THE CHARACTERIZATION OF HUMIC SUBSTANCES RESULTING FROM DECAY OF AQUATIC PLANTS IN SEDIMENTS AND WATERS,
Perpignan Univ. (France). Lab. of Marine Sedimentalogy and Geochemistry.
For primary bibliographic entry see Field 2H.
W88-04022

NUMERICAL TECHNIQUE TO CORRECT FOR WEAK ACID ERRORS IN GRAN FUNCTION ANALYSIS OF TITRATION DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W88-04023

MICROCOMPUTER-INTERFACED CONTINUOUS FLOW TOXICITY TEST SYSTEM,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W88-04028

APPLICATION OF TRACER TECHNIQUES TO CONTINUOUS-FLOW TOXICITY TESTING,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W88-04029

SULFATE AND GYPSUM DETERMINATION IN SALINE SOILS,
Minnesota Univ. Technical Coll., Waseca.
R. L. Skarie, J. L. Arndt, and J. L. Richardson.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 901-905, July-August 1987. 4 fig, 21 ref. USDA Grant No. 83-CRSR-2-2307.

Descriptors: *Sulfates, *Gypsum, *Saline soils, *Chemical analysis, Soil chemistry, Chromatography, Calcium.

A study was conducted to compare SO4(2-) in saturation extracts as estimated by difference with SO4(2-) measured by single-column ion chromatography for saline Aeric Calciaquolls and Typic Haplaquolls in eastern North Dakota. Results should be applicable throughout the Northern Great Plains. For extracts of sulfatic, saline soils, estimation of SO4(2-) by difference compared favorably with SO4(2-) determined directly. Results were more variable for highly chloridic soil extracts because errors from other methods were large relative to the amount of SO4(2-) present. Gypsum was determined by using a sufficiently dilute extract to completely dissolve the gypsum present in the soil sample. Gypsum content was calculated in two ways, based either on Ca(2-) or SO4(2-) measured in the dilute extract. For highly chloridic soils, gypsum contents based on Ca(2-) determination were essentially equal to the results based on SO4(2-) data. For sulfatic soils, gypsum contents were lower when Ca(2-) values were used due to loss of Ca(2-) to the exchange complex during the extraction process. (Author's abstract)
W88-04039

DETERMINATION OF FE(III) AND FE(II) IN OXALATE EXTRACTS OF SEDIMENT,
Geological Survey, Reston, VA. Water Resources Div.
E. J. P. Phillips, and D. R. Lovley.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 4, p 938-941, July-August 1987. 2 fig, 3 tab, 13 ref.

Descriptors: *Iron, *Sediments, *Chemical analysis, Heavy metals, Oxalate-extraction, Aerobic conditions.

A method was developed to determine the concentrations of oxalate-extractable Fe(III) and Fe(II) in sediments. Sediment was extracted in acid ammonium oxalate under N2. Iron(II) in the extract was determined with ferrozine. Iron(III) in the extract was reduced with hydroxylamine-hydrochloride, and total Fe in the extract was determined with ferrozine. Oxalite-extractable Fe(III)was calculated as the difference between Fe(II) and total Fe in the extract. Iron(II) was not oxidized, and Fe(III) was not reduced during the extraction. For an accurate estimate of oxalate-extractable Fe(III), fresh samples had to be analyzed, because air-drying or freeze-drying the sample oxidized Fe(II) to oxalate-extractable Fe(III). With a minimal increase in analytical effort, the method yields far more information on Fe geochemistry than the standard aerobic oxalate extraction method. (Author's abstract)
W88-04042

APPLICATION OF LANDSAT THEMATIC MAPPER TO INLET DYNAMICS, OLD DRUM INLET, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
J. T. Wells, and J. E. Camp.
Geology GLGYB, Vol. 15, No. 9, p 849-852, September 1987. 3 fig, 17 ref.

Descriptors: *Landsat, *Beach erosion, *Remote sensing, *Inlets, *Old Drum Inlet, *North Carolina, *Mapping, Satellite technology, Data acquisition, Hurricanes, Storms, Tides, Dynamics, Aerial photography.

During the early morning hours of September 27, 1985, Hurricane Gloria crossed the North Carolina coast near Cape Hatteras, opening several new inlets on the Outer Banks barrier-island chain. Landsat thematic mapper (TM) imagery was used to watch the closure of one of the breaches, Old Drum Inlet, and to test the applicability of the TM sensor to small-scale, high-frequency processes such as inlet dynamics. By photographically enlarging the 1:1,000,000 film negatives to a scale of 1:20,000, the progressive infilling of Old Drum Inlet over a four-month period was possible. Good spatial resolution (30-m pixel size) and a 16-day repetition rate are features that make the TM sensor particularly useful in inaccessible areas where aerial photography is acquired at irregular and infrequent intervals. (Author's abstract)
W88-04056

APPLICATIONS OF UNIVERSAL KRIGING TO AN AQUIFER STUDY IN NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2F.
W88-04058

METHODS OF DETERMINING SPECIFIC YIELD,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W88-04059

EXAMPLES OF TRANSIENT SOUNDING FOR GROUND-WATER EXPLORATION IN SEDIMENTARY AQUIFERS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W88-04060

SEISMIC REFLECTION STUDY OF A SHALLOW AQUIFER DURING A PUMPING TEST,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W88-04062

COMPARISONS OF GAUGE AND SATELLITE RAIN ESTIMATES FOR THE CENTRAL UNITED STATES DURING AUGUST 1979,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W88-04098

SAMPLING ERRORS IN SATELLITE ESTIMATES OF TROPICAL RAIN,
Pixel Analaysis, Silver Spring, MD.
For primary bibliographic entry see Field 2B.
W88-04099

SPACE-TIME STOCHASTIC MODEL OF RAINFALL FOR SATELLITE REMOTE-SENSING STUDIES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W88-04105

PHYSICAL MODELING AND ANALYSIS OF RAIN AND CLOUDS BY ANISOTROPIC SCALING MULTIPLICATIVE PROCESSES,
McGill Univ., Montreal (Quebec). Dept. of Physics.
For primary bibliographic entry see Field 2B.
W88-04112

AUTOMATIC RAIN GAUGE FOR CONTINUOUS, REAL TIME DETERMINATION OF RAINWATER CHEMISTRY,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. L. Ames, L. E. Roberts, and A. H. Webb.
Atmospheric Environment ATENBP, Vol. 21, No. 9, p 1947-1955, September 1987. 8 fig, 1 tab, 18 ref.

Descriptors: *Pollutant identification, *Rain gages, *Monitoring, *Measuring instruments, *Rain, *Chemical composition, Chemical analysis, Ions, Cations, Anions, Hydrogen peroxide, Computers,

Sampling, Rainfall rate, Temporal distribution, Data acquisition.

An automatic rain gage was developed which is capable of collecting rainwater and analyzing it continuously for the ions H(+), NH4(+), Na(+), Ca(2+), NO3(-), Cl(-), SO4(2-) and for dissolved H2O2. The wet-only rain collector, based on an inverting V-tray arrangement, is mounted on the roof of a small caravan, which contains the equipment for analysis. An indirect colorimetric method is used for SO4(2-) and a chemiluminescent method for H2O2; the other species are determined by ion-selective electrodes. The onset of rain is sensed either by a simple conductivity plate or by a modified float gage. In addition, equipment is installed to determine simultaneously gas-phase O3, NO, NO2 and SO2 and simple meteorological parameters. Data is recorded on disc by a microcomputer, which also handles automatic calibration and other control functions. The caravan as a whole is a fairly comprehensive, transportable air and rainwater monitoring package. The advantages of the rainwater sampling method are instantaneous concentrations that are measured continuously rather than daily or weekly averages, and elimination of problems associated with sample deterioration during storage. (Author's abstract)
W88-04141

IDENTIFICATION OF OIL SPILLS IN HARBOURS BY MEANS OF PATTERN RECOGNITION,
Katholieke Univ. Nijmegen (Netherlands). Inst. for Theoretical Physics.
For primary bibliographic entry see Field 5B.
W88-04164

VELOCITY AND DISCHARGE IN COMPOUND CHANNELS,
Ulster Univ., Coleraine (Northern Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04236

SOIL WATER DYE TRACING, WITH SPECIAL REFERENCE TO THE USE OF RHODAMINE WT, LISSAMINE FF AND AMINO G ACID,
Sheffield Univ. (England). Dept. of Geography.
S. T. Trudgill.
Hydrological Processes, HYPRE3, Vol. 1, No. 2, p 149-170, March 1987. 13 fig, 12 tab, 30 ref. Natural Environment Research Council (UK) Grants GR3/3459, GT/79/AAPS/48, and GT4/78/AAPS/46.

Descriptors: *Soil water, *Dyes, *Tracers, *Rhodamine WT, *Lissamine FF, *Amino G Acid, Fluorescence, Soil columns, Adsorption, Groundwater movement, Path of pollutants.

Three fluorescent dyes (Rhodamine WT, Lissamine FF and Amino G Acid) are compared for use in soil water tracing. Background fluorescence, adsorption, desorption, pH and other nonadsorptive effects are reviewed in the contexts of soil column work and field tracing of soil water. Lissamine FF and Amino G Acid are to be preferred for soil column work because of their lower adsorption; Rhodamine WT exhibits higher adsorption but is useful in field situations where organic fluorescence backgrounds are high. Semi-quantitative work may be undertaken in soil columns once a priming and flushing procedure has been adopted. The fluorescent dyes are very useful for the identification of the presence of soil water in groundnwater and streamwater systems. If the establishment of linkage is more important than the establishment of travel times then any one of the dyes may be used. In establishing pathways for pollutants, adsorbed dyes may be of use since they may mimic the behavior of other sorbed reactive solutes. Lissamine FF is the most useful dye for establishing travel times. (Lantz-PTT)
W88-04241

EVALUATION OF THE UNIVERSAL SOIL LOSS EQUATION AND FIELD TECHNIQUES FOR ASSESSING SOIL EROSION ON A TROPICAL ALFISOL IN WESTERN NIGERIA,
Sokoine Univ. of Agriculture, Morogoro (Tanzania).
For primary bibliographic entry see Field 2J.
W88-04244

400 YEARS OF CENTRAL CALIFORNIA PRECIPITATION VARIABILITY RECONSTRUCTED FROM TREE-RINGS,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W88-04281

USE OF RADAR TO DERIVE A STORM INTENSITY-DURATION CURVE,
Alberta Research Council, Edmonton. Resource Technologies Dept.
L. Wojtiw.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 849-855, October 1987. 4 fig, 17 ref.

Descriptors: *Remote sensing, *Depth-area-duration analysis, *Rainfall intensity, *Rainfall duration, *Radar, *Data acquisition, Alberta, Precipitation measurement, Return period, Feasibility studies, Storm runoff, Remote sensing, Computer programs.

Rainstorms which exceed the design capacity of conveyance systems and cause extensive damage to structures and property, occur frequently in Alberta. After such a severe storm, an early and quick assessment of the storm's location and magnitude and the corresponding frequency for various durations (storm intensity-duration curve) is often required to estimate the damage. The storm intensity-duration curve is produced with information obtained from a sparse network of recording raingages, creating a high degree of uncertainty in the result. Short-duration precipitation is usually quite variable in Alberta; hence, a very dense network of recording precipitation stations would be required to provide precise measurements of the storm intensity-duration curve at all locations. Such a dense network does not exist in Alberta; it would be very expensive to install and maintain, and difficult to justify financially. One solution for obtaining a large amount of closely spaced intensity-duration values is to use weather radar. Using weather radar data, intensity-duration curves could be produced routinely for any set of prespecified locations. The radar data then have the potential for facilitating the identification of the return period of rainfall events quickly, cheaply, and precisely when the long-term intensity-duration curves are available. As a pilot project to demonstrate the feasibility of the method and the potential of the radar data, computer software was developed to derive intensity-duration values from archived radar data for up to a 2,500 sq km area for a given storm. (Author's abstract)
W88-04286

COMPARISON OF SNOW COVER LIQUID WATER MEASUREMENT TECHNIQUES,
Colorado State Univ., Fort Collins.
H. S. Boyne, and D. Fisk.
Water Resources Research WRERAO, Vol. 23, No. 10, p 1833-1836, October 1987. 3 tab, 19 ref.

Descriptors: *Snow cover, *Liquid water, *Measuring instruments, *Calorimetry, *Comparison studies, Snow, Snowmelt, Freezing calorimetry, Alcohol calorimetry, Dilution.

The amount and distribution of liquid water are important for assessing the mechanical strength, meltwater generation, and meltwater transmission in snow. Liquid water also has a profound effect on the performance of active and passive remote sensing systems operating in the microwave and millimeter wave region of the electromagnetic spectrum. New methods of measuring liquid water were reported that show considerable promise. The question of measurement equivalence is addressed by comparing the three direct methods of freezing calorimetry, alcohol calorimetry, and dilution and by comparing the precision of a calibrated capacitance probe with one of the direct methods. All comparisons were made in a laboratory cold room with snow having a mass liquid water content of 0-14 mkg per 100 mkg of snow. The comparisons show that the methods are equivalent with an uncertainty of plus or minus 1.8 mkg per 100 mkg of snow. However, the operational achievement of equivalence is strongly dependent on a variety of factors such as sample size, mixing of snow and working fluid, and operator skill. (Author's abstract)
W88-04304

ION-CHROMATOGRAPHY IN THE ROUTINE ANALYSIS OF WATER AND ENVIRONMENTAL MATERIAL (DIE IONEN-CHROMATOGRAPHIE IN DER ROUTINEMAESSIGEN WASSER- UND UMWELTANALYTIK),
Labor fuer Geoanalytik, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W88-04323

FLOW-INJECTION METHOD FOR THE DETERMINATION OF TRACE AMOUNTS OF CHLORIDE (ENTWICKLUNG EINER FLIESSINJEKTIONSMETHODE ZUR BESTIMMUNG VON CHLORID IM SPURENBEREICH DURCH LEITFAEHIGKEITSDIFFERENZEN),
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie.
G. Lach, and K. Bachmann.
Analytica Chimica Acta ACACAM, Vol. 196, p 163-169, May 15, 1987. 2 fig, 4 tab, 9 ref.

Descriptors: *Chlorides, *Conductivity, *Chemical analysis, *Analytical methods, Trace levels, Hydrochloric acid, Acid rain, Clouds, Fog, Chromatography, Aerosols.

The indirect determination of chloride in water is based on measurement of the difference in conductivity after the sample has passed through ion-exchange columns in the hydrogen form and silver form. The linear response range is about 0.5-10 micrograms/gram chloride (with 3 micrograms/gram nitrate and 5 micrograms/gram sulfate); the detection limit is about 50 nanograms/gram chloride but depends strongly on the concentrations of other anions. A time-resolved analysis of cloud, fog, and rainwater has not yet been carried out but such analysis seems possible upon further optimization of the system. Use of small sample volumes has been realized; the currently necessary volume (50 microliters) has been cut in half. All components of the system are sturdy and non-sensitive. Space requirements are small, and use under difficult conditions (e.g. in airplanes) is possible. (Airone-PTT)
W88-04334

SPECTROPHOTOMETRIC DETERMINATION OF ZINC IN COOKING SALTS, TAP AND MINERAL WATERS WITH PHENYLGLYOXAL MONO(2-PYRIDYL)HYDRAZONE,
Seville Univ. (Spain). Dept. of Bromatology, Toxicology and Applied Chemical Analysis.
For primary bibliographic entry see Field 5A.
W88-04335

INVESTIGATIONS ON SPECTRAL INTERFERENCES IN ICP-AES (UNTERSUCHUNGEN UEBER SPEKTRALE INTERFERENZEN IN DER ICP-AES),
For primary bibliographic entry see Field 5A.
W88-04344

MEASUREMENT OF COARSE BED-LOAD TRANSPORT BY MEANS OF THE MAGNETIC TRACER TECHNIQUE (MESSUNG DES GROBGESCHIEBETRANSPORTES MIT DER MAGNETTRACERTECHNIK),
Freie Univ. Berlin (Germany, F.R.). Inst. fuer Physische Geographie.
For primary bibliographic entry see Field 2J.
W88-04348

INTERCOMPARISON TEST FOR CALIBRATING HYDROMETRIC CURRENT METERS (EIN RINGVERSUCH ZUR KALIBRIERUNG HYDROMETRISCHER FLUGEL),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
W. Teuber, and K. Wander.
Deutsche Gewaesserkundliche Mitteilungen DGMTAO, Vol. 31, No. 2/3, p 68-73, July 1987. 3 fig, 5 tab, 17 ref.

Descriptors: *Current meters, *Calibrations, *Measuring instruments, *River flow, Rivers, Floods, Comparison studies, Hydrology, Measuring instruments, Errors, Flow profiles.

The Federal Institute of Hydrology carried out an intercomparison test involving a small-scale current meter (Type Ott C2) and a universal current meter (Type Ott C31), each with different rotors. The universal meter was calibrated both as a rod-type and a float-type meter (100 kg center piece). In all, the calibration results of six current meter combinations tested in five calibrating institutes of the four Rhenish riparian states (Switzerland, Austria, Federal Republic of Germany, and the Netherlands) have been compared with one another. Four calibrating installations are operated with long flumes in which the current meter is drawn by a tow vehicle through tranquil water; one of the installations consists of an annular tube in which the blade of the fixed current meter is rotated by flowing water. For all six combinations the current meter equations of three of the institutes agreed closely, while the remaining two showed deviations up to 3%. The results indicated the following sources of uncertainty: problems in data registration (start and stop problems), number and distribution of measurement points, evaluation procedure to determine the current meter equations, consideration of the Epper effect, influence of the mode of current meter fastening, differences between calibration of rod-type and float-type meters, and differences between flumes and tube channels. At a workshop meeting in May 1986, a large number of suggestions were made for improvements and new developments. It is expected that several uncertainties detected in the test may be reduced in the future. When an optimum and standardized calibration is performed, it seems to be absolutely realizable to restrict the uncertainty to +/- 2%. (Airone-PTT)
W88-04349

ANALYSIS OF THE U. S. GEOLOGICAL SURVEY STREAMGAGING NETWORK,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7A.
W88-04415

SOCIO-ECONOMIC DEVELOPMENT LEVEL AND TECHNOLOGY POLICIES FOR WATER RESOURCES MANAGEMENT,
Departamento Nacional de Aguas e Energia Eletrica, Brasilia (Brazil). Div. de Controle de Recursos Hidricos.
For primary bibliographic entry see Field 6B.
W88-04439

AUTOMATIC DETECTION OF COLIFORM BACTERIA FOR INDUSTRIAL CONTROL OF DRINKING WATER QUALITY,
Societe Generale pour l'Agriculture, Rueil-Malmaison (France).
C. Bernard, G. Boissonnade, Y. Regnat, F. Colin, and M. J. Jourdain.
Water Research WATRAG, Vol. 21, No. 9, p 1089-1099, September, 1987. 9 fig, 5 tab, 31 ref.

Descriptors: *Measuring instruments, *Water quality control, *Coliforms, *Pollutant identification, *Drinking water, *Bacterial analysis, *Automation, Monitoring, Quantative analysis, Escherichia coli, Water analysis, Electrochemistry, Industrial water, Water quality.

An automatic electrochemical device was devised for the semi-quantative detection of coliform bacteria in drinking and tap water. The instrument, called an E. Colimeter, was built by the Environement S.A. company for the SOGEA company. The device features measurement cells with totally automatic operating cycles managed by a microprocessor. The detection of coliform bacteria in one measurement cell triggers the automatic operation of the second cell allowing confirmation of the contamination. At the end of the measurement cycle each cell drains and sterilizes itself, and is operational again after about 1 hour. If the water is found not to be contaminated, a sample is automatically taken every 5.5 hours. The difference between the results obtained with the automatic device and those obtained with the closest reference method, both expressed in terms of equivalent response time, varies from 0.2 to 31.4%. The E. Colimeter may be used to detect accidental contamination or to monitor situations of chronic contamination within the framework of the surveillance of water tap connections, treatment units and drinking water supply networks. (Geiger-PTT)
W88-04448

7C. Evaluation, Processing and Publication

QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS - II,
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
R. L. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149282/AS. Price codes: A02 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 121, June 1986. 6 p, 6 ref. Contract No. 14-08-0001-G1004. Project No. USGS G1004-32.

Descriptors: *Algae, *Lakes, *Reservoirs, *Water data, *Data storage and retrieval, Taxonomy, Classification, Habitat, Streams, Arkansas.

A database of the algae of Arkansas has been established by the use of a relational database management system (dBase III). The system was chosen to be readily available for microcomputers using MS and PC-DOS. The database contains taxonomic fields from division through variety, synonomy, authors, starting date and definitive descriptive source. The data is cross-referenced by ecoregion, community and subcommunity. The database contains nearly 1,500 taxonomic records in all division and classes of freshwater algae. These data are sortable by any of the included parameters. The data have been used to initiate the publication of the algal flora of Arkansas. The listing of the Cyanophyta/Cyanobacteria or bluegreen algae is presently available. (USGS)
W88-03499

LOCAL WATER RESOURCE INFORMATION MANAGEMENT SYSTEM,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
D. G. Parker, and S. C. Parker.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-149340/AS. Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville. AWRRC Publication No. 120, June 1986. 54 p, 5 ref, 4 append. Contract No. 14-08-0001-G1004. Project No. USGS G1004-33.

Descriptors: *Data storage and retrieval, *Data collections, *Water quality data, Computer programs, Data bases, Arkansas, Beaver Lake.

Water quality data from Beaver Lake, Arkansas, are stored in a relational database. It has been implemented using software called R:base 5000, a system available for microcomputors using MS- or PC- DOS operating systems. The data in the database include that concerned with the author(s), title, date of publication, agency doing the study, agency funding the study and complete reference for the document. Other aspects of the database are designed to allow retrievals based on any author, study dates, parameters measured and keywords. (USGS)
W88-03504

DEVELOPMENT OF A NATIONAL GROUNDWATER DATA BASE,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
For primary bibliographic entry see Field 2F.
W88-03771

AQUAMOD: A Z-DIMENSIONAL GALERKIN FINITE-ELEMENT SIMULATION PROGRAM FOR MICROCOMPUTERS FOR PREDICTION OF POLLUTANT TRANSPORT IN SATURATED GROUNDWATER FLOW (AQUAMOD: 'N TWEE-DIMENSIONELE GALERKIN EINDIGE ELEMENT SIMULASIEPROGRAM VIR MIKROEKENAARS VIR DIE VOORSPELLING VAN VERSADIGDE GRONDWATERVLOEI EN BESOEDELING),
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
For primary bibliographic entry see Field 2F.
W88-03773

ANALYSIS OF EMISSION DATABASES FOR REGIONAL MODELS,
National Center for Atmospheric Research, Boulder, CO. Acid Deposition Modeling Project.
P. Middleton.
Atmospheric Environment ATENBP, Vol. 21, No. 7, p 1497-1509, July 1987. 11 fig, 5 tab, 15 ref. EPA Interagency Agreement DW930144-01-1.

Descriptors: *Water pollution sources, *Acid rain, *Air pollution sources, *Monitoring, *Emissions data bases, *Regional models, *Data interpretation, *Model studies, *Regional analysis, Surveys, Air quality, Prediction.

General procedures for adapting atmospheric pollutant emission inventories to regional models and for studying the impact of differences in inventories on model predictions are outlined. To illustrate the methods, analysis of two inventories which are still being validated is presented. The inventories together satisfy current requirements for the NCAR regional acid deposition model (RADM). These include anthropogenic emissions of SO2, sulfate aerosol, NO, NO2, NH3 and volatile organic compounds (VOC) in 10 reactivity classes, from United States and Canadian point and area sources on 80-km grid resolutions, for weekend and weekday seasonally representative days on a diurnal basis during the 1980-1982 period. Application of checking procedures, designed to screen for subtle anomalies not identified at previous stages of quality assurance employed by the inventory developers, resulted in adjustments primarily to VOC emissions. Comparisons of the modified inventories, which provide an indication of uncertainties in emissions due to variations in inventory development procedures, revealed differences in the eastern United States total daily emissions to be at most on the order of 5% for SOx and NOx, 20% for VOC and 85% for NH3. Studies of the impact of inventory differences on predictions of RADM were conducted for the 22-24 April 1981 period, which was monitored as part of the Oxidation and Scavenging Characteristics of April Rains program. Event total wet sulfate deposition differed by 10% or less while midday O3 concentrations differed by 1% or less for individual grids over the modeling domain. (Author's abstract)
W88-03777

EVALUATION OF SIMPLE, DYNAMIC SOIL MOISTURE MODEL,
Portland State Univ., OR. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W88-03781

ALGEBRAIC COMPUTATION OF FLOW IN FURROW IRRIGATION,
Universidade Federal do Ceara, Fortaleza (Brazil). Dept. of Agriculture Engineering.
For primary bibliographic entry see Field 3F.

W88-03786

SURFACE-IRRIGATION NONLINEAR OPTIMIZATION MODELS,
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W88-03787

ALTERNATIVE METRIC UNITS FOR ACRE-FOOT AND ACRE-INCH,
Nebraska Wesleyan Univ., Lincoln.
M.-L. Quinn.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 393-404, August 1987. 2 fig, 36 ref.

Descriptors: *Acre-foot, *Acre-inch, *Notation, *Hectare-meter, *Hectare-centimeter, Metric units, Measurement systems, Irrigation, Hydrology.

Acre-foot is an important water measurement term in the United States, particularly in the American west. Although less common, its derivative, acre-inch, is widely used within the irrigation community. No meaningful equivalents for these terms exist in the current International System of Units (SI). The two metric equivalents proposed here, hectare-meter for acre-foot and hectare-centimeter for acre-inch, are presented as alternatives to those generally found in SI conversion tables. Each is conceptually similar to its counterpart in the U.S. Customary System, thus creating comparable mental images that, in turn, greatly aid comprehension. Official recognition within SI of these two proposed metric equivalents deserves serious consideration. During the course of almost a century, acre-foot and acre-inch have evolved with the needs of irrigation and hydrology in the United States. As a result, they have acquired not only practical but cultural and historical significance, becoming part of a heritage that should not be lost. Measurement bilingualism is recommended as a new policy for the federal government, to replace that of voluntary metrication adopted in 1975. Such a policy would expand our communication skills while maintaining linguistic diversity. (Author's abstract)
W88-03788

MODELING VOLATILE ORGANICS IN THE DELAWARE ESTUARY,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W88-03792

INFLUENCE OF TEMPERATURE ON OXYGEN TRANSFER,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W88-03793

THEORY OF DECLINING RATE FILTRATION. I: CONTINUOUS OPERATION,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
For primary bibliographic entry see Field 5F.
W88-03800

THEORY OF DECLINING RATE FILTRATION. II: BANK OPERATION,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
For primary bibliographic entry see Field 5F.
W88-03801

TRANSIENT RESPONSES INCORPORATING PRODUCTS FORMATION,
Wisconsin Univ., Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-03802

LAKE ACIDIFICATION MODEL: PRACTICAL TOOL,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-03803

TRANSFORMATION OF REGULAR WAVES,
Manchester Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-03804

DERIVATION OF FLOW DURATION CURVES IN NORTHERN IRELAND,
Ulster Univ., Coleraine (Northern Ireland). Dept. of Environmental Studies.
For primary bibliographic entry see Field 2E.
W88-03805

NUMERICAL SIMULATION OF OROGRAPHIC ENHANCEMENT OF RAIN WITH A MESOSCALE MODEL,
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
For primary bibliographic entry see Field 2B.
W88-03807

PRECIPITATION DISCRIMINATION FROM SATELLITE INFRARED TEMPERATURES OVER THE CCOPE MESONET REGION,
Research and Data Systems, Inc., Lanham-Seabrook, MD.
For primary bibliographic entry see Field 2B.
W88-03808

ECOLOGICAL MODELS AS SUPPORT SYSTEMS TO DECISIONS IN LAKE MANAGEMENT PLANNING,
Pavia Univ. (Italy). Centro di Ricerca sulle Acque.
For primary bibliographic entry see Field 5G.
W88-03863

MIXTURE TOXICITY INDICES IN ACUTE LETHAL TOXICITY TESTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5A.
W88-03866

NOTE ON THE EFFECT OF FALLOWING ON WATER STORAGE AND LOSS AS DETERMINED FROM A LYSIMETER FOR A TROPICAL CLAY SOIL,
Kenya Agricultural Research Inst., Nairobi.
For primary bibliographic entry see Field 2G.
W88-03877

HYDROLOGY OF THE PRICE RIVER BASIN, UTAH, WITH EMPHASIS ON SELECTED COAL-FIELD AREAS,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03904

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BOZEMAN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 38, 1985. 1 sheet (map), 1 fig, 11 ref.

Descriptors: *Geohydrologic units, *Structural geology, *Carbonate rocks, *Aquifers, *Geologic maps, *Montana, Madison Group, Crazy Mountains basin.

The configuration of the top of the rocks of the Madison Group in the Bozeman Quadrangle, Montana, is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the westward deepening Crazy Mountains basin along the north side of the Absaroka Range and the east side of the Bridger Range. Rocks and structures of the overthrust belt along the front of the Rocky Mountains overlie and mask the western side of the basin. Contour intervals are 500 and 1,000 feet. (USGS)
W88-03912

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, HARDIN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 37, 1984. 1 sheet, 1 fig, 6 ref.

Descriptors: *Geohydrologic units, *Structural geology, *Maps, *Montana, Carbonate rocks, Aquifers, Geohydrology, Madison Group.

The configuration of the top of the rocks of the Madison Group is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the northern end of the Powder River basin, the east end of the Lake Basin fault zone, and the north flank of the Bighorn Mountains. The regional dip of the rocks is east and southeast from the Bighorn Mountains into the Powder River basin. The contour intervals are 100 and 500 feet. (USGS)
W88-03913

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, WHITE SULPHUR SPRINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 39, 1985. 1 sheet (map), 1 fig, 11 ref.

Descriptors: *Geohydrologic units, *Structural geology, *Carbonate rocks, *Aquifers, *Geologic maps, *Montana, Madison Group, Crazy Mountains basin.

The configuration of the top of the Madison Group in the White Sulphur Springs Quadrangle, Montana is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the westward deepening of the Crazy Mountains basin. Along the west side of the basin, rocks and structures of the overthrust belt along the front of the Rocky Mountains overlie and mask the configuration of the basin. In this area, contour intervals are 500 to 1,000 feet. The igneous intrusive rocks that form the core of the Crazy Mountains in the center of the basin do not greatly affect the sloping configuration of the basin. Northeast of the Little Belt Mountains the rocks dip into the Judith basin and southeast the beds dip toward Little Elk and Big Elk domes. The contour intervals in these areas are 100 and 500 feet. (USGS)
W88-03914

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BILLINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver,

CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 36, 1984. 1 sheet, 1 fig, 12 ref.

Descriptors: *Maps, *Geohydrologic units, *Structural geology, *Montana, Carbonate rocks, Aquifers, Hydrogeology, Geohydrology, Madison Group.

The configuration of the top of the Madison Group is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the Lake Basin fault zone, Nye-Bowler lineament, north end of the Big Horn basin, Reed Point syncline, and north and west flanks of the Pryor Mountains. The contour intervals are 500 and 1,000 feet. (USGS)
W88-03915

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, ROUNDUP 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 35, 1984. 1 sheet, 1 fig, 12 ref.

Descriptors: *Maps, *Geohydrologic units, *Structural geology, *Montana, Carbonate rocks, Aquifers, Geohydrology, Madison Group.

The configuration of the top of the Madison Group is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. This map shows the anticlines and synclines of the central Montana uplift, Wheatland syncline, Womans Pocket anticline, Bull Mountains basin, Shawmut anticline, Big Coulee-Hailstone dome, and the west end of the Lake Basin fault zone. The contour intervals are 100 and 500 feet. (USGS)
W88-03916

GROUNDWATER HYDROLOGY OF THE GUYANDOTTE RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
J. S. Bader.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Dept. of Natural Resources, Charleston, Groundwater Atlas, 1984. 1 sheet, 6 fig, 5 tab, 16 ref.

Descriptors: *Groundwater, *Water quality, *Saline water, *West Virginia, *Maps, Geohydrologic units, Water yield, Perched water, Appalachian Plateaus Physiographic Province, Guyandotte River basin.

This atlas report describes the groundwater resources of the Guyandotte River basin in West Virginia, and is, in part, based upon an earlier report describing the total water resources of that same basin. The basin of 1,680 sq mi lies in southwestern West Virginia. Precipitation, which averages about 45 inches/year, is the principal source of groundwater recharge. Water levels in wells is highest in spring and lowest in fall. There are few places where the quantity of groundwater at shallow depth is inadequate for domestic use. Well yield ranges from 0.5 to 340 gal/min, but the average in the various geologic units ranges from 14 to 27 gal/min. Wells in valleys generally yield more water than wells in other topographic locations. Groundwater quality, as determined from numerous wells in the basin, is highly variable. Concentrations of dissolved solids ranged from 21 to 3,420 mg/L; hardness ranges from 3 to 1,900 mg/L; concentrations of iron range from 0 to 180,000 micrograms/L; and concentrations of chloride range from 0 to 2,200 mg/L. (USGS)
W88-03917

GROUNDWATER HYDROLOGY OF THE UPPER NEW RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
R. A. Shultz.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Dept. of Natural Resources, Charleston, Groundwater Atlas, 1984. 1 sheet, 15 fig, 3 tab, 16 ref.

Descriptors: *Groundwater, *Well yield, *Maps, *West Virginia, Water quality, Water supply, Specific capacity, Karst, Valley and Ridge, Appalachian Plateaus Physiographic Province, Upper New River basin.

This atlas report describes the groundwater resources of the upper New River basin in West Virginia based on three earlier reports on the hydrology of the same basin. The basin drains 2,570 sq mi in southeastern West Virginia and extends from the northermost edge of the Pocahontas County to the southwest edge of Mercer County. Precipitation is the principal source of groundwater recharge, averaging close to 40 inches basinwide and ranging from more than 44 inches in the northwestern part to less than 36 inches in the southeastern part. The yield of wells ranges from 0.5 to 500 gallons/min and varies with topographic location, geologic structure, and geologic unit. Hilltop wells and a few hillside wells may fail to supply enough water for domestic use. Wells in valleys generally yield the greatest amounts of water. The chemical quality of the groundwater varies widely, but is generally good for most uses. In places, it is subject to quality problems resulting from excessive concentrations of hardness, iron, and manganese. (USGS)
W88-03918

GROUNDWATER HYDROLOGY OF THE TUG FORK AND TWELVEPOLE CREEK BASINS, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
J. S. Bader.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Dept. of Natural Resources, Charleston, Groundwater Atlas, 1984. 1 sheet, 6 fig, 7 tab, 15 ref.

Descriptors: *Groundwater, *Water quality, *West Virginia, *Maps, Saline water, Geohydrologic units, Water yield, Wells, Tug Fork River basin, Appalachian Plateaus Physiographic Province.

This study describes the groundwater resources of the Tug Fork and Twelvepole Creek basins in southwestern West Virginia in atlas format. The basins cover an area of 1,440 sq mi. Precipitation, which averages about 45 inches/year, is the principal source of groundwater recharge. Water levels in wells is highest in spring and lowest in fall. The quantity of groundwater at shallow depth is inadequate for domestic use in some areas. Well yield ranges from 0.25 to 400 gallons/min, but the median in the various geologic units ranges from 3.2 to 60 gallons/min. Wells in valleys generally yield more water than wells in other topographic locations. Groundwater quality is highly variable. Concentrations of dissolved solids range from 47 to 6,790 mg/L; hardness ranges from 1 to 6,900 mg/L; concentration of iron range from 10 to 67,000 micrograms/L; and concentrations of chloride ranges from 0.6 to 9,500 mg/L. Saline water circulates from depth to the groundwater surface in several areas in the lower two thirds of the basin. (USGS)
W88-03919

GROUNDWATER HYDROLOGY OF THE COAL RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
D. S. Beckwith.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Dept. of Natural Resources, Charleston, Groundwater Atlas, 1984. 1 sheet, 14 fig, 6 tab, 22 ref.

Descriptors: *Groundwater, *Water quality, *Saline water, *Maps, *West Virginia, Geohydrologic units, Water yield, Perched water, Appalachian Plateaus Physiographic Province, Coal River basin.

This atlas report describes the groundwater resources of the Coal River basin in West Virginia and is, in part, based upon an earlier report describing the water resources of that basin. The basin drains 890 sq mi in southern West Virginia. Precipitation, which averages about 45 inches/year, is the principal source of groundwater recharge. There are few places where groundwater supply at shallow depth is inadequate for domestic use. The yield of wells ranges from 1 to 402 gallons/min and varies with topographic setting, geologic structure, and well depth. Shallow wells, in valleys and/(or) near the axis of highly fractured zones, such as faults, lineaments, and anticlinal folds, generally yield more water than wells in other locations. Groundwater quality is highly variable, but generally suitable for most domestic uses. Concentration of dissolved solids ranges from 40 to 3,860 mg/L; hardness from 0 to 2,000 mg/L; iron from 0 to 2,500 micrograms/L; and chloride from 1 to 2,260 mg/L. (USGS)
W88-03920

GROUNDWATER HYDROLOGY OF THE MONONGAHELA RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
W. A. Hobba.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. West Virginia Dept. of Natural Resources, Charleston, Groundwater Atlas, 1984. 1 sheet, 8 fig, 5 tab, 9 ref.

Descriptors: *Groundwater, *Water quality, *Perched water, *Mine water, *West Virginia, Water table, Virginia, Maps, Appalachian Plateaus, Physiographic Province, Monongahela River basin.

This atlas report summarizes the groundwater resources of the Monongahela River basin in West Virginia from earlier investigations of the water resources in all or parts of the same basin. The river basin is 78 miles wide and 93 miles long and drains 4,225 sq mi in north-central West Virginia. Precipitation ranges from 40 to 70 inches/year and averages about 50 inches. Recharge to the groundwater reservoir is estimated to be about 7 inches/year. The Allegheny Formation, the Pottsville, Greenbrier, and Pocono Groups typically are the best aquifers. The yield of wells tapping these rocks averages 45 gallons/min and may be as high as 350 gallons/min. Transmissivity values for these formations range from 300 to 3600 sq ft/day. Wells located in valleys or on fracture zones yield more water than wells located on hills or nonfractured areas. In places, underground coal mining and mine subsidence have modified the local hydrology by causing lower groundwater levels and increased infiltration along subsidence cracks. Groundwater quality was determined from 425 partial chemical analyses and 112 complete laboratory chemical analyses. Water from the Permian and Upper Pennsylvanian rocks consistently contains more dissolved minerals than water from the Lower Pennsylvanian rocks. Water from the pre-Pennsylvanian rocks generally contains less dissolved minerals than the Permian or Pennsylvanian rocks. (USGS)
W88-03922

GROUNDWATER CONDITIONS IN THE KAIPAROWITS PLATEAU AREA, UTAH AND ARIZONA, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-03925

SINKHOLE FEATURES OF FLORIDA,
Geological Survey, Tampa, FL. Water Resources

Div.
W. C. Sinclair, and J. W. Stewart.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Florida Bureau of Geology, Tallahassee, Map Series, 1985. 1 sheet, 1 fig, 10 ref.

Descriptors: *Karst, *Sinkholes, *Maps, *Florida, Solution sinkholes, Cover-collapse sinkholes, Cover-subsidence sinkholes, Geohydrology.

Thickness and type of cover-material overlying limestone are used to define four areas of sinkhole activity in Florida. Solution sinkholes and collapse sinkholes occur throughout most of the State. Solution sinkholes form over a long period of time as subsidence of soil layers occurs. This type of sinkhole generally forms a bowl-shaped depression that is typical of much of Florida topography. Collapse sinkholes are more dramatic and occur when a solution cavity develops under clay beds until the beds can no longer support the weight, and collapse is abrupt and sometimes catastrophic. The four areas, differentiated by type and thickness of cover material, range from bare or thinly covered limestone (Area I) to areas of cover material greater than 200 feet thick (Area IV). Most collapse sinkholes occur in Area III where the cover material is 30 to 200 feet thick and the limestone is overlain by clayey sediments. (USGS)
W88-03927

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CUT BANK 1-DEGREE BY 2-DEGREE QUADRANGLE,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 33, 1984. 1 sheet, 1 fig, 11 ref.

Descriptors: *Geohydrologic unit, *Structural geology, *Maps, *Montana, Carbonate rock, Aquifers, Geohydrology, Madison Group.

The configuration of the top of rocks of the Madison Group is shown by contours on a base map of a scale of 1:250,000. The map is one of a series produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the westward dip of the rocks of the South arch, Marias River saddle, and Kevin-Sunburst dome of the Sweetgrass arch into the 'disturbed belt' of the Rocky Mountains. The contour intervals are 100 and 500 feet. (USGS)
W88-03945

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CHOTEAU 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis.
Available from USGS, OFSS, Box 25425, Denver, CO 80225. Montana Bureau of Mines and Geology, Butte, Geologic Map 34, 1984. 1 sheet, 1 fig, 11 ref.

Descriptors: *Geohydrologic units, *Structural geology, *Maps, *Montana, Carbonate rocks, Geohydrology, Aquifers, Madison Group.

The configuration of the top of rocks of the Madison Group is shown by contours on a base map of a scale of 1:250,000. The map is one of a series of maps produced as part of a regional study of the geohydrology of the Madison Group in eastern Montana. The map shows the west and southwest dip of the rocks from the South arch area of the Sweetgrass arch into the 'undisturbed belt' of the Rocky Mountains. The contour intervals are 100 and 500 feet. (USGS)
W88-03946

METHODS OF DETERMINING SPECIFIC YIELD,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W88-04059

SEEPAGE FACE SIMULATION USING PLASM,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2F.
W88-04065

SAMPLING ERRORS IN SATELLITE ESTIMATES OF TROPICAL RAIN,
Pixel Analaysis, Silver Spring, MD.
For primary bibliographic entry see Field 2B.
W88-04099

COKRIGING RADAR-RAINFALL AND RAIN GAGE DATA,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2B.
W88-04100

ESTIMATION OF SURFACE MOISTURE AVAILABILITY FROM REMOTE TEMPERATURE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
A. L. Flores, and T. N. Carlson.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 8, p 9581-9585, August 1987. 4 fig, 12 ref. NASA grant NAG-5-184.

Descriptors: *Satellite technology, *Remote sensing, *Data interpretation, *Infrared imagery, *Moisture availability, Air temperature, Mathematical models, Spatial distribution, Precipitation, Soil temperature, Semiarid lands, Mapping, Soil water.

Analyses of moisture availability, determined from GOES infrared surface temperature measurements and a boundary layer model, and antecedent precipitation are presented for data taken over Texas and Argentina. Correlations between antecedent precipitation and moisture availability are high (approximately 0.8) where the spatial variation in moisture availability (or ground temperature) is much larger than an inherent uncertainty in the method, which was judged to be about + or - 0.2 for the moisture availability parameter. In regions where there are large gradients of precipitation the infrared method can provide useful information on variations in soil moisture availability and, by implications in precipitation. (Author's abstract)
W88-04101

FRACTAL STRUCTURE AND EXPONENTIAL DECORRELATION IN RAIN,
Quebec Univ., Montreal.
For primary bibliographic entry see Field 2B.
W88-04102

NEW METHOD FOR QUALITATIVE SIMULATION OF WATER RESOURCES SYSTEMS. 1. THEORY,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
A. S. Camara, M. Pinheiro, M. P. Antunes, and M. J. Seixas.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2015-2018, November 1987. 1 fig, 6 ref. Junta Nacional de Investigacao Cientifica e Tecnologica Contract No. 808.86.110.

Descriptors: *Water resources, *Expert systems, *Simulation analysis, *Model studies, *Theoretical analysis, SLIN, *Mathematical models, *Water resources development, Data processing.

A new linguistic dynamic modeling methodology (SLIN) models systems defined by variables which may be qualitative or quantitative, grouped in layers and with values evolving through time. Simulation of qualitative variables is performed by applying a set of logical rules. Most important of these are base rules which may be either based on 'trees' enumerating all possible operations between the values of dependent variables at time t + dt and the values of independent variables at time t or built-in operators. SLIN was developed using a pragmatic algorithmic philosophy. There are many potential developments still to be pursued. From a theoretical standpoint, robustness has to be achieved by exploring traditional set theory and multivalued logics. Other extensions already studied on a preliminary basis include the interchange between quantitative and qualitative information flows, simulation-optimization applications, and the use of SLIN in the context of multiexpert system modeling. (See also W88-04178) (Lantz-PTT)
W88-04177

NEW METHOD FOR QUALITATIVE SIMULATION OF WATER RESOURCES SYSTEMS. 2. APPLICATIONS,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
M. P. Antunes, M. J. Seixas, A. S. Camara, and M. Pinheiro.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2019-2022, November 1987. 3 fig, 4 tab, 2 ref, 2 append. Junta Nacional de Investigacao Cientifica e Tecnologica Contract No. 808.86.110.

Descriptors: *Water resources, *Simulation analysis, *Expert systems, *Water resources development, *Model studies, Computer programs, SLIN, Case studies, Data processing.

SLIN is a new dynamic simulation methodology which rests on expert based rules of the if...then type. This methodology, easily implemented via PROLOG, may be advantageously used to model data scarce or strictly qualitative water resources systems. Two such applications of the SLIN methodology are presented. The first application is a simple environmental impact model of a hydropower dam scheduled to be built near Amarante in historic Northern Portugal. A model using SLIN was developed illustrating how expert rules are defined and incorporated. The results obtained showed that maximum electrical production will negatively impact the region. The second example deals with the potential usefulness of an expert-based model under crisis situations such as oil spills in the ocean after a tanker wreck. This model is greatly simplified at the current stage but efforts are underway to improve its spatial and temporal refinement and add logical rules representing biological, chemical, and physical processes. As a final note, it should be mentioned that these two simple models are included for mere illustrative purposes of a new qualitative simulation approach which was developed as an expert system modeling tool. From a methodological standpoint, there are no significant obstacles, however, in using SLIN to model more complex problems. (See also W88-04177) (Lantz-PTT)
W88-04178

ACCURACY OF AREAL RAINFALL ESTIMATION: A CASE STUDY,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
For primary bibliographic entry see Field 2B.
W88-04190

USE OF HISTORIC FLOOD INFORMATION IN ESTIMATING FLOOD PEAKS ON UNGAGED WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04296

IMPROVED ALGORITHMS FOR RESERVOIR CAPACITY CALCULATION INCORPORATING STORAGE-DEPENDENT LOSSES AND RELIABILITY NORM,
Indian Inst. of Science, Bangalore. Dept. of Computer Science and Automation.
For primary bibliographic entry see Field 2E.
W88-04302

PARAMETER ESTIMATION OF TEMPORAL RAINFALL MODELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W88-04305

DAGAN MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: FOUNDATIONAL ASPECTS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2F.
W88-04307

STATISTICAL MODELING OF SPACE-TIME RAINFALL USING RADAR AND RAIN GAGE OBSERVATIONS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 2B.
W88-04310

MONTE CARLO STUDIES OF SAMPLING STRATEGIES FOR ESTIMATING TRIBUTARY LOADS,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5B.
W88-04315

PATTERN OF DISTRIBUTION OF RADIUM 226 IN DRINKING WATER OF TEXAS,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W88-04320

MODELING OF EVAPOTRANSPIRATION FROM HOMOGENEOUS SOILS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2D.
W88-04322

INTERCOMPARISON TEST FOR CALIBRATING HYDROMETRIC CURRENT METERS (EIN RINGVERSUCH ZUR KALIBRIERUNG HYDROMETRISCHER FLUGEL),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W88-04349

COMPARISON OF TWO METHODS FOR SIMULATION OF SOIL-WATER BALANCE PROCESSES WITH SPECIAL REGARD TO GROUND-WATER RECHARGE (VERGLEICH ZWEIER METHODEN ZUR SIMULATION DER PROZESSE DES BODENWASSERHAUSHALTS, VORNEHMLICH DER GRUNDWASSERNEUBILDUNG),
Amt fuer Wasser- und Abfallwirtschaft, Muenster (Germany, F.R.).
For primary bibliographic entry see Field 2G.
W88-04350

RESULTS OF MAPPING A GROYNE-FIELD OF THE ELBE RIVER NEAR SCHNAKENBEK (ERGEBNISSE DER KARTIERUNG EINES BUHNENFELDES IN DER ELBE BEI SCHNAKENBEK),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2J.
W88-04351

DIMENSIONLESS S-GRAPHS FOR URBAN WATERSHEDS,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04391

COMPARATIVE STUDY OF INLAND WATER QUALITY - SAO PAULO (BRAZIL), FRANCE AND ENGLAND,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
For primary bibliographic entry see Field 5G.
W88-04425

DISTRIBUTION AND ABUNDANCE OF TIDAL MARSHES ALONG THE COAST OF MAINE,
Maine Univ. at Orono. Inst. for Quaternary Studies.
For primary bibliographic entry see Field 2L.
W88-04480

8. ENGINEERING WORKS

8A. Structures

STEEP SLOPE SEWER CONSTRUCTION CRITERIA,
D. Eckstein.
Public Works PUWOAH, Vol. 118, No. 5, p 89-90, May 1987.

Descriptors: *Soil erosion, *Slope protection, *Soil conservation, *Pipe lines, *Plastics, *Engineering, *Abrasion, *Sewer systems, *PVC pipes, Flow, Abutments, Maintenance, Materials engineering, Slope stabilization, Conveyance structures.

Installation of sewer lines up and down slopes is a source of concern. Special design considerations are deemed prudent at slopes in excess of 20 degrees. Areas of concern are constructability, thrust restraints, abrasion, maintenance and erosion. PVC sewer pipe has proven to be a natural for the rough terrain of steep installations. Thrust restraint in steep slope applications must consider slippage and energy produced in change of velocity of media. The abrasion resistance of PVC pipe mandates that abrasion will not limit design considerations. Maintenance aspects of a steep slope sewer line are very positive. Drop manholes or clean-outs should be provided for easy cleaning of problem areas. Erosion associated with steep slope sewer construction can be minimized through backfilling, bedding and other methods. PVC pipe's light weight and ease of handling and installation, and other constructability factors make it worth consideration. (Main-PTT)
W88-03599

INFRASTRUCTURE AND THE ENVIRONMENT,
For primary bibliographic entry see Field 6A.
W88-03608

DAM WATER INTAKE WITH TIERED TUNNELS,
S. S. Golik.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 9-12, October 1986.

Descriptors: *Dams, *Water intakes, *Tunnels, *Soviet Union, *Earth dams, *Construction, *Seismic activities, *Geologic aspects, Mountains, Design, Earthquakes, Concrete, Rock, Foundation, Shaft, Water diversion, Water supply, Pipes, Crimea, Ukraine, Foreign research, Reservoirs, Potable water, Engineering.

A water intake was constructed in the Crimea at a 70-m-high earth dam. The design and location of the intake was substantially affected by the high design seismic activity of the region and canyon-like profile of the river valley. The intake consists of four main elements: a tower, three-tiered tunnels, pipeline, and distribution chamber. The lining of the tiered tunnels is made of in-situ reinforced concrete 35-45 cm thick, the inside diameter is 230-234 cm, the lengths are 61 m and 180 m. The intake tower is also made of in-situ reinforced concrete. It consists of a round dry chamber and a rectangular wet chamber. The height of the tower is 65 m, the outside diameter is 8.1 m, the inside diameter is 6.5 m, and the wall thickness is 80 cm. The wet chamber has vertical-lift guard-emergency gates and trash racks. The dry chamber has vertical steel pipelines connected to the chamber by connecting pipes with slide valves. Water flows along the pipeline tunnel from the tower to the distribution chamber. The length of the tunnel is 465 m, the cross section is round, and the lining is 55-cm-thick. Considering geological features, an intake with tiered tunnels at an earth dam is the most economical and provides diversion of the river and intake of water during construction, high reliability of operation, stability of the structure, and meets the requirements of the operating service imposed on the intake of water from the reservoir. (Main-PTT)
W88-03618

COMPARISON OF THE TENSILE STRENGTH OF CONCRETE AND STEEL-FIBER CONCRETE IN BLOCKS OF A TUNNEL LINING,
For primary bibliographic entry see Field 8F.
W88-03623

RECONSTRUCTION OF ASPHALT SHAFT WATERBARS OF CONTRACTION JOINTS OF SECTIONS OF THE POWERHOUSE AT THE LOWER KAMA HYDROELECTRIC STATION,
T. N. Ryumina, and G. T. Pestov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 613-617, April 1987. 3 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 47-50, October 1986.

Descriptors: *Asphalt, *Waterbars, *Contraction joints, *Hydroelectric stations, *Construction joints, *Materials engineering, *Soviet Union, *Plastics, Kama River, Dams, Joint leaks, Hydroelectric power, Economic aspects, Alluvial soils, Earth dam, Engineering, Hydraulics.

The Lower Kama hydroelectric station on the Kama River is a typical run-of-river hydrostation with respect to design and layout. The powerhouse is combined with outlets and is divided into eight sections, and the sections are separated by 30-cm-wide contraction joints. The cavity of the joints between sections is sealed by asphalt shaft waterbars. During temporary operation of the hydrostation considerable leaks into the joint were observed. Restoration of the existing shaft waterbars consisted of reducing the inflow into the expanded joints so they could be cleaned and resetting the stop logs and sealing the spare water bar with plastic mastic and equipping it with a reliable mastic heating system. The cost of the works per 1 m of the shaft water bar was 125 rubles. (Main-PTT)
W88-03628

CAST-IN-PLACE PIPE PROCESS SAVES TIME AND MONEY,
R. Doss.
Public Works PUWOAH, Vol. 118, No. 4, p 36-38, April 1987.

Descriptors: *Pipes, *Casting, *Drainage engineering, *Storm drainage, *Construction, *Engineering, *Pipelines, *Storm sewers, *New Mexico, Concrete, Reinforced concrete, Drainage systems, Economic aspects, Trenches, Sewers, Lasers, Grade control.

Cast-in-place-pipe (CIPP) construction was used for the construction of the Copper Avenue Drainage Project. The proposed outlet consisted of about 19,000 ft of concrete pipe in 78-, 84-, 90-, and 96-in diameters. The project had to be completed in less than 240 calendar days from the date construction began. The final engineer's cost estimate was $3.3 million for the CIPP process and $4.9 million if reinforced concrete pipe was used. Five different pipe sizes were used on the project which required different buckets, forms, and CIPP machines for each pipe segment. Grade control for the pipe was done with a laser placed on a tripod in the bottom of the trench. The strength of the cast-in-place-pipe structure permitted inline man-

holes to be built on top of the pipe. The final project cost was $3.6 million. (Main-PTT)
W88-03629

DENVER'S LONG DISTANCE RAW SLUDGE TRANSFER PAYS OFF,
Metropolitan Denver Sewage Disposal District No. 1, CO.
For primary bibliographic entry see Field 5E.
W88-03633

LONG-TERM DEFORMATION AND FAILURE OF BURIED PLASTIC PIPES,
LUTAB A.B., Bromma (Sweden).
For primary bibliographic entry see Field 8G.
W88-03684

DESIGN OF BURIED STRUCTURES IN SQUEEZING ROCK IN TORONTO, CANADA,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 8E.
W88-03754

CANAL DESIGN: OPTIMAL CROSS SECTIONS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 8B.
W88-03784

CIRCULAR GATES IN CIRCULAR AND U-SHAPED CHANNELS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W88-03790

CONTRACTION RATIOS FOR WEIR AND FLUME DESIGNS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 8B.
W88-03791

NONCIRCULAR SEWER DESIGN,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-03799

LOWER BOUND FOR THE THICKNESS OF REVETMENT BLOCKS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. M. Townson.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 83, No. 2, p 397-407, June 1987. 9 fig, 1 tab, 4 ref.

Descriptors: *Design criteria, *Revetment blocks, *Harmonic pressure, *Breakwaters, *Sea walls, *Bank protection, *Hydrodynamics, *Filter layer, Waves, Downrush, Model studies.

An estimate is made of the response of a facing block, free to rotate about its lower edge, to simple harmonic pressure variation in a free-flowing filter layer. It is therefore shown that, depending on filter layer response and wave steepness, waves of a height of some four times block thickness may cause the entire upper edge to become exposed during downrush. The concept is supported by results from simple model tests. (Author's abstract)
W88-03806

ROLLED CONCRETE DAMS USING GAP-GRADED AGGREGATE,
For primary bibliographic entry see Field 8F.
W88-03833

ROCK FOR BREAKWATER CONSTRUCTION IN WESTERN AUSTRALIA - ITS AVAILABILITY AND INFLUENCE ON DESIGN,
Geological Survey of Western Australia, Perth.
For primary bibliographic entry see Field 8G.
W88-03998

GEOLOGICAL FACTORS IN SPILLWAY TERMINAL STRUCTURE DESIGN,
Water Resources Commission, Sydney (Australia).
R. C. Woodward.
Engineering Geology EGGOAO, Vol. 22, No. 1, p 61-70, September 1987. 3 fig, 1 tab, 3 ref.

Descriptors: *Geohydrology, *Rock properties, *Spillways, *Hydraulic properties, *Rock mechanics, Design floods, Flow patterns, Rocks, Erosion, Wales.

Fourteen spillways designed or operated by the Water Resources Commission of New South Wales were studied with respect to the geological, topographic and operational factors which influence the type of terminal structure provided. In the case of frequently operating spillways of moderate head and moderate unit discharge at design flood, unlined or partially lined spillways with no provision for energy dissipation can be constructed in durable, lowly stressed rock with rock quality designation (R.Q.D.) generally greater than 75% and erodible seams generally absent. Full energy dissipators are required in rock with R.Q.D. generally less than 50% and erodible seams generally present. (Author's abstract)
W88-03999

UNDERSEEPAGE AT THE LOY YANG SETTLING POND DAM,
State Electricity Commission of Victoria, Melbourne (Australia).
For primary bibliographic entry see Field 8B.
W88-04000

SPILLWAY GATES AND BOTTOM OUTLET AT KOTMALE DAM,
Lewin Fryer and Partners, Hampton (England).
J. Lewin.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 8, p 11-14, August 1987. 4 fig, 7 ref.

Descriptors: *Spillways, *Gates, *Kotmale Dam, *Hydraulic structures, Outlets, Hydroelectric plants, Electric power production, Weirs.

The Kotmale project is one of the five major headworks projects undertaken under the Accelerated Mahaweli Ganga scheme in Sri Lanka. It is the uppermost project in the scheme, and develops the potential of a major right bank tributary of the Mahaweli Ganga, the Kotmale Oya. It consists essentially of a regulating reservoir on the Kotmale Oya, formed by the Kotmale dam at a point about 6.6 km above its confluence with the Mahaweli Ganga. A system of tunnels then leads the regulated flow to an underground powerplant and discharges it into the Mahaweli approximately 6.4 km downstream of its confluence with the Kotmale. The primary function of the project is power generation, but additional benefits will also arise from the increased regulation of river flows. The spillway is located on the left bank and the sluiceways are in the form of a three-bay gated structure designed for a probable maximum flood 5560 cu m/sec. The sluiceways are arranged in an arc of 60 m radius, to align the flow with the upper tapering section of the spillway. Radial gates control the discharge. Each is 14 m wide with a gate height of 16.75 m. The sill level is at el. 687.6 m and is located 0.23 m below and 2.65 m downstream of the weir crest level. The normal upstream retention level is el. 703 m, which results in a head of 15.4 m, on the gates. The pivot radius is 17.25 m and the gate is supported by three gate arms on each side. (Lantz-PTT)
W88-04047

CONCRETE PILLARS AND TRIAXIALLY PRESTRESSED ANCHORAGES FOR LARGE RADIAL GATES,
Porto Univ. (Portugal). Faculdade de Engenharia.
For primary bibliographic entry see Field 8F.
W88-04049

EVALUATION OF UNCERTAINTY IN FLOOD MAGNITUDE ESTIMATOR ON ANNUAL EXPECTED DAMAGE COSTS OF HYDRAULIC STRUCTURES,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 6C.
W88-04179

OPTIMIZING SPILLWAY CAPACITY WITH AN ESTIMATED DISTRIBUTION OF FLOODS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Engineering and Public Policy.
For primary bibliographic entry see Field 8B.
W88-04181

SUBSURFACE SEAWATER INTRUSION BARRIER ANALYSIS,
Miyazaki Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-04237

DESIGN OF STORMWATER DETENTION BASINS FOR MULTIPLE DESIGN FREQUENCIES,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-04268

STABILITY OF ROCK PROTECTION ON SLOPES,
For primary bibliographic entry see Field 4D.
W88-04389

ANDEKALEKA GATHERING TUBE HYDROPOWER INTAKE,
Hydro Monenco Consultants Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 8C.
W88-04396

INITIATIVE FOR RISK-BASED FLOOD DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6F.
W88-04398

MULTIOBJECTIVE ANALYSIS IN OPTIMAL SOLUTION OF HYDRAULIC NETWORKS,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Meccanica e Aeronautica.
For primary bibliographic entry see Field 8B.
W88-04403

HEAD LOSS IN SUBMERGED DROP STRUCTURES,
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-04411

TOWARDS CONTROL OF AN ESTUARY,
Ministry of Transport and Public Works, The Hague (Netherlands).
For primary bibliographic entry see Field 2L.
W88-04428

8B. Hydraulics

NEW DESIGNS OF SPILLWAYS AT EARTH DAMS,
Z. A. Musaev.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 569-575, April 1987. 4 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 12-17, October 1986.

Descriptors: *Spillways, *Earth dams, *Dam design, *Inlets, *Soviet Union, *Bazarchai Reservoir, *Reservoirs, Head, Reservoirs, Hydraulics, Economic aspects, Dams, Trenches, Inflow, Circulation, Water diversion, Flow, Channels.

When designing reservoir structures, overflow spillways should be designed to increase the overflow length with the limited planar dimensions of the inlet by transferring the region of water conveyance within the inlet to a lower elevation from the free surface and using the water space freed for additional intake of water. The placement in the trench of additional channels with spillway walls on transverse beams makes it possible to increase the length of overflow and the capacity of the spillway up to three times. The weight of the inlet, spillway walls, and water above the spillway reduce the uplift pressure on the structure foundation which lightens the proposed spillway layouts. Water inflow into the trench in transverse and longitudinal direction provides uniform joining of the additional water masses to the main flow over the entire area of the free water surface in the trench. This eliminates transverse circulation and creates normal hydraulic conditions of flow in the inlet and in the water passage of the spillway. (Main-PTT)
W88-03619

CHARACTERISTICS OF TURBULENCE OF THE BOTTOM REGION OF A FLOW,
A. Y. Kuz'minov, and D. V. Shterenlikht.
Hydrotechnical Construction HYCOAR, Vol. 20 No. 10, p 580-585, April 1987. 4 fig, 22 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 22-24, October 1986.

Descriptors: *Turbulent flows, *Sediment transport, *Scour, *Turbulence, *Soviet Union, *Hydrodynamics, *Bottom sediments, *Mathematical models, Erosion, Formulas, Empirical formulas, Calculations, Measurements, Foreign research, Currents, Flow.

A flow under conditions of the start of erosion of a fine-sand bottom were investigated. All experiments were conducted in a glass flume 10 x 29.5 m. The water depths in the flume varied from 0.7 to 9.5 cm. The experiments were conducted under a uniform flow for three slopes 0.005, 0.001, and 0.005. Measurements were taken at 60 depths from the head of the flume. Kinematic characteristics of the flow were measure by a laser Doppler flowmeter on the axial vertical. The majority of the experiments were conducted with a tranquil state of flow. Results showed that a logarithmic distribution of the mean longitudinal velocities was preserved near the bottom. The complex character of water motion in the thin bottom region of the flow was also shown. (Main-PTT)
W88-03621

SOME REFINEMENTS OF THE CONTRACTION AND RESISTANCE COEFFICIENTS IN THE CASE OF A SUDDEN CONTRACTION OF THE FLOW,
I. E. Idel'chik.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 591-594, April 1987. 3 fig, 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 29-31, October 1986.

Descriptors: *Inlet contraction, *Resistance coefficients, *Flow, *Hydraulics, *Mathematical models, *Hydrodynamics, *Soviet union, Mathematical equations, Mathematical analysis, Foreign research, Pipes, Engineering, Model studies, Water vessels.

Previously, on the basis of the Bernoulli equations of momentum, a relation between the hydraulic resistance coefficient of an inlet with a sudden contraction and the ratio of the cross-sectional areas of the pipe and vessel were obtained. An erroneous empirical formula, which does not correspond to the experimental data, is given in many literature sources when determining the resistance coefficient in the case of a sudden contraction. Numerous experiments make it possible to introduce a correction for the coefficient of the filling the cross section (the contraction coefficient) in the case of a sudden contraction and flow through an orifice under various conditions. The general case of flow through an orifice breaks down into a number of particular cases: inlet with a sudden expansion; outlet into unlimited space; aperture in a wall; orifice with sharp edges; deep orifice with sharp edge at inlet; and beveled or rounded orifice edges. (Main-PTT)
W88-03624

EXPERIMENTAL INVESTIGATIONS OF THE DEFORMATION OF CHANNELS OF SAND CANALS,
For primary bibliographic entry see Field 2J.
W88-03625

RHEOLOGICAL PROPERTIES OF DISPERSED CEMENT GROUTS,
For primary bibliographic entry see Field 8F.
W88-03626

RESISTANCE TO FLOW IN GRAVEL-BED RIVERS,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-03642

ULTRASONIC FLOW MEASUREMENT IN PIPES AND CHANNELS,
Rittmeyer A.G., Zug (Switzerland).
For primary bibliographic entry see Field 7B.
W88-03683

CANAL DESIGN: OPTIMAL CROSS SECTIONS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
L. E. Flynn, and M. A. Marino.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 335-355, August 1987. 2 fig, 3 tab, 12 ref, append. ARS Cooperative Agreement 4350-H.

Descriptors: *Design criteria, *Canals, *Optimization, *Cross sections, *Construction, *Hydrodynamics, Flow, Excavation, Computers.

Canal cross-section designs for uniform flows are contrasted and compared by using nondimensional shape parameters. The basic relations among the cross-section shapes and design variables (the wetted perimeter, the water depth, the water surface width, the cross-sectional area, the lining volume, the excavation volume, etc.) are exposed. These relations are used to uncover robust rules that can determine optimal canal designs for elementary problems, directly from flow information such as capacity, velocity, slope, and roughness. For problems involving complex limits and economics, the relations are combined with optimization methods to solve for the economically optimal cross sections. The possible cross sections are parameterized by at most two variables, so the calculations do not require the use of sophisticated optimization methods or large computers. (Author's abstract)
W88-03784

CIRCULAR GATES IN CIRCULAR AND U-SHAPED CHANNELS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 413-419, August 1987. 7 fig, 3 ref.

Descriptors: *Equations, *Circular gates, *Channels, *Hydrodynamics, *Gages, *Gates, *Hydraulic gates, *Flow measurement, *Stage-discharge relations, Discharge head, *Channel flow, Coefficients, Surface area, Flow.

The discharge-head relation of flows in circular and U-shaped channels under circular thin plate gates is established. The coefficient of discharge is determined experimentally and it is found that only the effect of the relative gate opening is significant. Peculiarities of the free surface downstream of the gate section are described in detail. (Author's abstract)
W88-03790

CONTRACTION RATIOS FOR WEIR AND FLUME DESIGNS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, M. G. Bos, and J. A. Replogle.
Journal of Irrigation and Drainage Engineering JIDEDH (ASCE), Vol. 113, No. 3, p 420-424, August 1987. 3 fig, 4 ref.

Descriptors: *Equations, *Design criteria, *Weirs, *Flumes, *Channels, *Gaging, *Discharge measurement, *Stage-discharge relations, *Stream gages, *Froude number, *Hydrodynamics, Sediments, Flow, Surface area.

A new approach to the design of flumes and weir for open channels is developed. The approach is based on matching the flume to approach channel conditions thus providing an appropriate Froude number in the approach channel for the passage of sediment and for producing a stable readable water surface at the head measurement station. The procedure is graphical and is applicable to approach sections and control sections of any shape. (Author's abstract)
W88-03791

NONCIRCULAR SEWER DESIGN,
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee, R. Bhargava, and A. K. Sharma.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 4, p 824-833, August 1987. 4 fig, 4 tab, 3 ref.

Descriptors: *Noncircular sewers, *Design criteria, *Construction, *Sewers, *Sewer hydraulics, *Hydrodynamics, Flow, Velocity, Discharge, Sewers.

A direct and simple method is presented for the determination of sewer geometry of circular and noncircular shapes for partly full-flowing conditions with the known variables being discharge, bed slope, and Mannings roughness coefficient. Methodology has been developed for satisfying the minimum and maximum velocity constraints in a design procedure. A criteria of time of existence of self-cleaning velocity has been suggested for checking against self-cleaning velocity. It is hoped that this criteria will rationalize the design procedure. (Author's abstract)
W88-03799

TRANSFORMATION OF REGULAR WAVES,
Manchester Univ. (England). Dept. of Civil Engineering.
R. H. Swift, and J. C. Dixon.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 83, No. 2, p 359-380, June 1987. 13 fig, 19 ref.

Descriptors: *Wave transformation, *Shoaling waves, *Waves, *Hydrodynamics, Design standards, Prediction, Equations, Shallow water, Energy.

Results are presented from calculations for shoaling waves using a development of Dean's nonlinear stream function which display better agreement with previous experimental data for parallel waves in shallow water than other currently available theories. The results are presented in a manner suitable for design applications. In addition to wave height evaluation, curves have been given to aid the prediction of other parameters of design interest, such as crest elevation and horizontal water particle velocity. It is demonstrated that the stream function series type of solution is particularly suitable for this application, because the integral wave properties required for shoaling predictions may be obtained directly from the stream function

solution, without performing integrations in the body of the wave. It is also shown that the conservation of wave action flux and wave energy flux lead to identical results in terms of wave shoaling predictions. (Author's abstract)
W88-03804

LOWER BOUND FOR THE THICKNESS OF REVETMENT BLOCKS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W88-03806

FLUID MECHANICS AND UNIT OPERATIONS,
Missouri Univ.-Rolla. Dept. of Chemical Engineering.
D. S. Azbel, and N. P. Cheremisinoff.
Ann Arbor Science, Ann Arbor, MI. 1983. 1160 p.

Descriptors: *Hydraulics, *Fluid mechanics, *Hydrodynamics, Model studies, Mathematical studies, Hydrostatic pressure, Laminar flow, Turbulent flow, Viscous flow, Pipe flow, Pumps, Sedimentation, Thickening, Clarification, Centrifugation, Mixing, Filtration, Fluidized beds, Entrainment, Settling velocity, Bernoulli equation, Eddies, Friction, Heat transfer, Kinetics, Mass transfer, Shear, Stokes law.

A book on fundamentals of applied fluid mechanics is divided into four sections: approaches to problem analysis, modeling, and fluid transport properties; internal problems of hydrodynamics, external hydrodynamics, and mixed problems of hydrodynamics. The unit operation concept allows an industrial practice to be treated generally, even though it may be used in several industries. In addition to introductory information on fluid mechanics, unit operations, modeling, hydraulic processes, and hydrostatics, some specific subjects of interest to the water and hydropower industries are flow regimes, hydraulic resistance in pipe flow, fluid transport by pumps, sedimentation, thickening, clarification, centrifugal separation, mixing, filtration, fluidized beds, entrainment, and bubbling. (Cassar-PTT)
W88-03979

GEOLOGICAL FACTORS IN SPILLWAY TERMINAL STRUCTURE DESIGN,
Water Resources Commission, Sydney (Australia).
For primary bibliographic entry see Field 8A.
W88-03999

UNDERSEEPAGE AT THE LOY YANG SETTLING POND DAM,
State Electricity Commission of Victoria, Melbourne (Australia).
S. J. Fletcher, and I. V. Pedler.
Engineering Geology EGGOAO, Vol. 22, No. 1, p 71-81, September 1987. 7 fig, 6 ref.

Descriptors: *Dam stability, *Dams, *Seepage, *Loy Yang Dam, *Settling basins, Hydraulic structures, Piezometry, Geohydrology, Groundwater level, Structural geohydrology, Power stations.

The Loy Yang Settling Pond was constructed at Traralgon South in the Latrobe Valley, Victoria, to service the 4000 MW brown coal-fired Loy Yang Power Project during its construction and operation. Filling of the Pond commenced in October 1979 and pressures monitored by foundation piezometers and groundwater observation bores indicated that underseepage was occurring. The monitoring and investigation programs are described, and the geohydrological models postulated to explain the cause and extent of underseepage and the effect of underseepage on the stability of the dam are presented and discussed. Details of the relief well installation, operation and effectiveness are also discussed. (Author's abstract)
W88-04000

PREVENTING CAVITATION IN FRANCIS RUNNERS,
Bharat Heavy Electricals Ltd., Bhopal (India).
M. N. Khan.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 8, p 15-16, 21, August 1987. 3 fig, 4 ref.

Descriptors: *Cavitation, *Hydraulic profiles, *Francis turbines, Flow, Fluid mechanics, Boundary layer suction, Flow splitters, Costs, Economic aspects.

The problem of leading edge cavitation is mainly observed in medium-head Francis runners. The phenomenon has been reported in recent years in relation to machines at the Krasnoyarsk and Bratsk powerhouses in the USSR. The problem has also occurred at the La Grande 2 powerhouse in Canada. For machines already in operation, four remedial measures are suggested, two based on the principle of boundary layer suction, one based on flow splitting, and one based on a modification of the leading edge in the near-skirt zone. Of the four methods considered, those based on the boundary layer suction method are likely to be the most inexpensive yet the most effective to solve the problem of leading edge cavitation. (Lantz-PTT)
W88-04048

WATERHAMMER AND GOVERNOR ANALYSIS,
Clifton and Associates, Seattle, WA.
L. Clifton.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 8, p 31-32, 35-39, August 1987. 12 fig, 8 ref.

Descriptors: *Waterhammer, *Water pressure, *Pressure transients, *Hydraulic properties, Flow profiles, Hydraulic models, Elasticity, Mathematical models, Model studies.

Pressure transients, known as waterhammer, occur whenever the flow through a reaction turbine changes. These pressure transients affect the stability of governors and limit the quality of speed regulation obtainable for a given amount of rotational inertia. An accurate waterhammer model is therefore necessary to predict the performance of reaction turbine governors. Since the incompressible waterhammer model overestimates the magnitude of the pressure transients, it might be expected that the design formulae derived from this model would be conservative. When the compressibility of the water and the elasticity of the penstock begin to have a significant effect the gains for a stable governor are lower than expected from the incompressible model. Also the quality of speed regulation will be less than that predicted by the incompressible model. By using the simple incompressive water-hammer model, the speed of deviation would be underestimated by almost a factor of two. (Lantz-PTT)
W88-04051

OPTIMIZING SPILLWAY CAPACITY WITH AN ESTIMATED DISTRIBUTION OF FLOODS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Engineering and Public Policy.
D. Resendiz-Carrillo, and L. B. Lave.
Water Resources Research WRERAO, Vol. 23, No. 11, p 2043-2049, November 1987. 5 fig, 3 tab, 22 ref. NSF Grant No. CES-86 19699.

Descriptors: *Spillways, *Flood control, *Hydraulic structures, *Flow control, Dams, Costs, Flood damage, Construction costs, Flood peak, Case studies, Rio Grande River, Embudo, New Mexico.

A model of social cost minimizing spillway capacity for dams was constructed using: (1) the estimated distribution of peak flows from historical data, (2) the estimated relationship between spillway capacity and cost, and (3) a characterization of downstream flood damage from dam failure. Net social cost is the sum of construction costs and expected flood damage. This model is applied to data for the Rio Grande River at Embudo, New Mexico. Minimum social cost is attained at a spillway capacity much smaller than that needed to handle a probably maximum flood. (Author's abstract)
W88-04181

MIXING IN RIVER UNDERFLOW,
Western Australia Univ., Nedlands.
For primary bibliographic entry see Field 2E.
W88-04232

NEGATIVELY BUOYANT FLOW IN A DIVERGING CHANNEL. I: FLOW REGIMES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
T. R. Johnson, G. J. Farrell, C. R. Ellis, and H. G. Stefan.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 716-730, June 1987. 21 fig, 12 ref, append. NSF Grant No. CEE 8308471.

Descriptors: *Diffusers, *Turbidity currents, *Density currents, *Buoyant flow, *Channels, *Flow profiles, Hydraulic profiles, Diverging channels, Hydraulic models, Negative buoyancy, Mathematical studies, Channel flow.

Negatively buoyant (plunging) flow entering a horizontal and diverging channel has been studied in the laboratory. Such flow is found at the heads of reservoirs and near effluent sites into lakes. Six flow regimes could be distinguished in the experiments. The flows are similar to nonbuoyant, two-dimensional diffuser flow, but negative buoyancy adds several variations. Six main flow regimes were observed. Flow patterns were observed at four inflow channel aspect ratios and diffuser half angle from 3 ato 90 degrees. The observations are reported in the form of photographs fand graphs that can be used to predict flow separation and stall for aspect ratios from 0.48 to 7.9 and inflow densimetric Froude numbers from 1.5 to 10. (Lantz-PTT)
W88-04233

NEGATIVELY BUOYANT FLOW IN A DIVERGING CHANNEL. II: 3-D FLOW FIELD DESCRIPTIONS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
T. R. Johnson, C. R. Ellis, G. J. Farrell, and H. G. Stefan.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 731-742, June 1987. 19 fig, 7 ref, append. NSF Grant No. CEE 8308471.

Descriptors: *Diffusers, *Turbidity currents, *Density currents, *Buoyant flow, *Channels, *Flow profiles, *Three-dimensional flow, *Field tests, Buoyancy, Hydraulic models, Negative buoyancy, Mathematical studies, Stratified flow.

Diffuser flow concepts are explained and related to observations made in the experimental setup in part 1 of this paper. Six flow regimes were identified for the negatively buoyant flow in a diverging horizontal channel by following dye tracers placed either in the inflowing or ambient water. The flow regimes were related to several independent variables and illustrated. The internal diffuser flow mechanics and controlling forces, are emphasized, especially the effects of buoyancy. The entire plunging flow field may be divided into three regions: a momentum-dominated region (upstream) and a buoyancy-dominated region (downstream) separated by the plunging region. In the momentum-dominated region, the flow pattern is basically that of a nonbuoyant flow. In the buoyancy-dominated region the flow changes to a stratified two-layer system. Far downstream the underflow is symmetrical and radial. The number of flow regimes given in part 1 may be reduced by considering flow mechanics. Three basic ideas are particularly helpful. First, if the diffuser were of infinite length the downstream flow condition would, in all buoyant flow cases, be a uniformly stratified flow. Because the diffuser in the experiments is of finite length, stratified flow may not be seen. The observed flow, therefore, may only be the upstream portion of a larger complete flow field. Second, the flow patterns observed in nonbuoyant 2-D diffuser flow are still present in the momentum-dominated part of the flow and the upper

layer of ambient return flow is superimposed over these flow patterns. Finally, buoyancy can reduce or eliminate separated flow and transverse mixing regions. (See also W88-04233) (Lantz-PTT)
W88-04234

VELOCITY AND DISCHARGE IN COMPOUND CHANNELS,
Ulster Univ., Coleraine (Northern Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04236

QUICK STROKING: DESIGN OF TIME-OPTIMAL VALVE MOTIONS,
Alabama Univ., University. Dept. of Mechanical Engineering.
D. E. Goldberg, and C. L. Karr.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 6, p 780-795, June 1987. 11 fig, 1 tab, 12 ref, 2 append. NSF Grant No. MSM-8451610.

Descriptors: *Quick stroking, *Hydraulic properties, *Hydraulic structures, *Valves, Valve motions, Unsteady flow, Computer programs, Computer models, Pipe flow, Pipes, Model studies.

Despite major advances in the science of pipeline transient analysis, design for unsteady flow remains largely an art. A fast, simple, yet effective technique for valve-motion synthesis called quick stroking (QS) is presented in general and as a BASIC computer program for execution on widely available personal computers. The method is also applied to several single pipe example problems, including cases with high or low pipe friction, and upstream or downstream valve locations. These case studies show the QS procedure to be a fast and simple method of synthesizing time-optimal valve motions. A sensitivity analysis demonstrated the insensitivity of QS with linear interpolation to wave-speed errors. The same analysis showed the importance of the intentional underestimation of wave-speed values when using the more rapid WS valve motion. (Lantz-PTT)
W88-04238

GYARMATI PRINCIPLE AND OPEN-CHANNEL VELOCITY DISTRIBUTION,
Guangdong Research Ins., Guangzhou (China).
H. C. Hou, and J. R. Kuo.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 563-572, May 1987. 2 fig, 2 tab, 14 ref, append.

Descriptors: *Gyarmati principle, *Open-channel flow, *Flow velocity, Mixing, Mathematical studies, Mathematical equations, Channel flow.

The relationship between mixing-length theory and nonlinear theory was studied for analysis of velocity distribution in open-channel flow. The equation of motion for open-channel flow can be obtained by the Gyarmati integral, which includes the linear and nonlinear terms of dissipation potential. The velocity distribution for laminar and turbulent flows in an open channel can be deduced by this integral. The relationship between the theory of minimum energy dissipation rate and the Gyarmati principle shows that the constitutive structure of the mixing-length model is valid in principle from the thermodynamic point of view. For the simple case of quasi-uniform river flow, the Gyarmati integral of maximization should be reduced to the theory of minimum energy dissipation rate. (Author's abstract)
W88-04265

ENTROPY AND PROBABILITY CONCEPTS IN HYDRAULICS,
Pittsburgh Univ., PA.
C. L. Chiu.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 583-600, May 1987. 7 fig, 9 ref, append.

Descriptors: *Hydraulics, *Entropy, *Sediment transport, *Hydraulic properties, *Open-channel flow, Flow velocity, Shear stress, Suspended sediments, Mathematical studies, Probabilistic process.

The concept of entropy based on probability has been applied in modeling the vertical distributions of the velocity, shear stress, and (suspended) sediment concentration in open-channel flows. A velocity distribution equation derived by the entropy-maximization principle has advantages over the Prandtl-von Karman universal velocity distribution equation. The (maximized) entropy functions derived for the velocity distribution and sediment transport are effective in reflecting the effects of the size of suspended sediment, coarseness of bed material, and sediment concentration. They can, therefore, be used as variables for characterizing and comparing various open-channel flows. Through their sensitivities to the various parameters needed to describe flow and sediment transport characteristics, entropy functions can also be used to obtain much-needed, new equations for the estimation of parameters difficult to determine owing to insufficient numbers of equations available. The entropy concept provides an excellent vehicle for introducing probability into hydraulics, and such an introduction makes dealing with uncertainties inherent in hydraulic processes possible. This can help develop sampling schemes, in addition to modeling and parameter estimation. (Author's abstract)
W88-04267

INITIAL DILUTION OF HORIZONTAL JET IN CROSSFLOW,
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04269

HYDRAULICS OF SHALLOW AND STRATIFIED MIXING CHANNEL,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5E.
W88-04270

EXPERIMENTAL INVESTIGATION OF UNSTEADY SUBMERGED AXISYMMETRIC JETS,
Clemson Univ., SC. Dept. of Civil Engineering.
F. M. Fang, and B. L. Sill.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 663-669, May 1987. 3 fig, 3 ref, append. NSF Grant No. CEE-8213187.

Descriptors: *Mixing, *Jets, *Hydraulic properties, *Submerged jets, Flow velocity, Axisymmetric flow, Turbulent flow, Flow profiles, Discharge.

The centerline velocity decay of unsteady axisymmetric turbulent jets was investigated. By using a new time scale, T, jet centerline velocity behavior (for a ramp discharge variation) can be categorized. Results show that for large values of T sub f/T sub i (where T sub i and T sub f are the travel times to a measurement station for parcels released at t=o and t=delta t) the jet behaves essentially in a steady fashion, while for small values of T sub f/T sub i the velocities depart from those calculated by steady analyses. It appears that the times T sub f and T sub i are useful in categorizing unsteady jets with ramp discharges as steady or unsteady in behavior. Primary results may be summarized as follows: (1) An appropriate time scale to describe the centerline velocity of an unsteady nonbuoyant axisymmetric jet is found, based on steady state calculations, and it represents the travel time for a released fluid parcel to reach a certain downstream distance; and (2) At a fixed downstream location for T sub f/T sub i > 30, the jet behaves essentially as a steady discharge with respect to centerline velocity. For 5 < T sub f/T sub i < 30, the jet still behaves in a quasi-steady fashion. With values for T sub f/T sub i < 1, the jet is obviously unsteady in behavior. (Lantz-PTT)
W88-04272

HYDRAULICS OF TWO-LEVEL DENIL FISHWAY,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, C. Katopodis, and L. Flint-Petersen.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 5, p 670-674, May 1987. 1 fig, 2 ref.

Descriptors: *Fishways, *Hydraulic properties, *Denil fishway, Hydraulic structures, Channels, Baffles, Design criteria, Flow profiles.

Among the several designs of Denil fishways that have been tested, the generally used design is the so-called simple Denil. The simple Denil consists of a rectangular flume of full width B, housing baffles that reduce the clear width to b, and a V-shaped vane at the bottom. In the so-called standard design, B = 0.56 m (22 in), b = 0.36 m (14 in), the spacing of the baffles is 0.25 m (10 in), and the baffles are placed at an angle of 45 degrees to the (upstream) bed. This design, along with some minor variations, has been previously studied for use in inland waterways in western Canada. When a Denil fishway has to be designed with a large d/b ratio, it is advisable to install a roof at a height of 3b, thereby producing a two-level Denil. When the depth d for a given flow is less than the height d sub l of the lower Denil, it will function as a simple Denil. If d > d sub l, then the lower Denil will act like a conduit and the upper Denil will carry the excess flow. It appears to be a good idea to make the baffles in the upper Denil identical to those of the simple Denil. The two-level Denil is much better than the simple Denil when the d/b ratio is very large from fish passage considerations. (Lantz-PTT)
W88-04273

ONSET OF UNDERFLOW IN SLIGHTLY DIVERGING CHANNELS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. Akiyama, and H. G. Stefan.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 7, p 825-844, July 1987. 17 fig, 3 tab, 17 ref, append. NSF Grant No. CEE 830 8471.

Descriptors: *Density currents, *Underflow, *Diverging channels, Hydraulic properties, Inflow, Flow profiles, Water temperature, Hydraulic design, Mathematical analysis, Mathematical studies.

Experiments were conducted in a horizontal laboratory channel with slightly diverging walls to simulate buoyancy driven plunging flow. A temperature difference between inflow and downstream ambient provided the density differential that initiates the underflow. Temperature profiles and flow visualization were used to determine flow conditions in the plunge region. Channel divergence angles (half-angles) from 1-15 degrees were investigated. Volumetric flow rates in the sinking flow increase from 0-45% during the plunging process. Maximum entrainment rates were nearly linearly related to divergence angle. Depths of the underflow downstream from the plunge line were from 0.65-0.9 times the depth at the plunge line. Densimetric Froude numbers from 0.56-0.89 occur at the plunge line, depending on the channel divergence angle and the discharge densimetric Froude number. A flow analysis that explains and supports the experimental data is presented. Channel expansion affects the plunging process significantly, particularly entrainment rates and densimetric Froude numbers at plunging. (Author's abstract)
W88-04387

FLOW OF SURFACE BUOYANT JET IN CROSS FLOW,
Hydrological Research Unit, Wallingford (England).
For primary bibliographic entry see Field 5B.
W88-04390

STEADY FLOW OVER AN OBSTACLE,
University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
G. A. Lawrence.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 981-991, August 1987. 7 fig, 10 ref, append. NSF Grant No. CEE-8212073.

Descriptors: *Hydraulic jump, *Fluid mechanics, *Steady flow, *Hydraulic properties, Hydraulic friction, Flow profiles, Friction, Flow rates.

A classification scheme derived from basic hydraulic principles predicts the regime of steady flow over a fixed obstacle. An interesting feature of the scheme is prediction that for the same range of parameters both a supercritical flow and a flow with a stationary upstream hydraulic jump are possible. Experiments confirm this result and show that the nature of the flow is dependent on the history of its establishment. The extent of the hysteresis loop is less than predicted, since the length of the obstacle and the length of the jump are assumed to be much less than the distance from the jump to the obstacle. Frictional effects fix the position of the jump. In previous theories, developed primarily for flow over a towed obstacle, bores were found to move away from the obstacle at a constant speed, since friction was neglected. This results in a lower flow rate over the obstacle than the flow rate upstream. When this difference is taken into account, the results for the fixed obstacle case are reconciled with those for the towed obstacle case. (Lantz-PTT)
W88-04393

TWO-DIMENSIONAL BUOYANT JETS IN TWO-LAYER AMBIENT FLUID,
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-04394

SELF-SUSTAINED PRESSURE OSCILLATIONS IN TWO-DIMENSIONAL CAVITY,
Southern Illinois Univ. at Carbondale. Dept. of Civil Engineering and Mechanics.
S. Sami, and H. Memar.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 1055-1061, August 1987. 5 fig, 6 ref.

Descriptors: *Fluid mechanics, *Cavities, *Pressure oscillations, *Hydraulic properties, Mathematical studies, Mathematical models, Regression analysis.

The two-dimensional flow taking place above a cavity is strongly influenced by the cavity geometry. The free-shear layer initiating at the upstream face and impinging upon the trailing edge of the cavity is the principal feedback mechanism responsible for the self-excitation and amplification of the oscillating flow. At certain values of the cavity chord-to-depth ratio, the dimensionless frequency appears to jump from one level into another. The frequency at which such oscillations take place within the cavity can be predicted. A mathematical model, obtained by developing a regression analysis on previously published data, agrees quite well with the results of experimental measurements. For a given chord-to-depth ratio of the cavity, this study of two-dimensional flow provides an estimation of the maximum amplitude of oscillation to be expected within the cavity. (Lantz-PTT)
W88-04399

WEAK VORTICES AT VERTICAL INTAKES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. S. Gulliver, and A. J. Rindels.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 1101-1116, September 1987. 9 fig, 21 ref, append.

Descriptors: *Vortices, *Hydraulic equipment, *Hydraulic properties, *Intakes, Vertical intakes, Mathematical analysis, Mathematical studies, Weak vortices, Eddies.

Weak, free surface vortices at vertical intakes with a headrace channel are defined by the first observance of a persistent dye core upon dye injection. Dimensionless parameters describing free surface vortex flows were used in an analysis of experimental data. The experimental results indicate that a large dimensionless submergence is required to avoid weak vortices at vertical intakes. Most vertical intakes will therefore require some type of antivortex device if weak vortices are to be avoided. The required dimensionless submergence is also highly dependent upon approach flow angle and headrace length/width ratio. (Author's abstract)
W88-04401

SOLUTIONS FOR LATERAL INFLOW IN PERFORATED CONDUITS,
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
Z. Siwon.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 1117-1132, September 1987.

Descriptors: *Intakes, *Lateral inflow, *Perforated conduits, *Hydraulic properties, *Mathematical analysis, Flow profiles, Pipes, Permeability, Hydraulic structures, Inflow.

A one-dimensional model for a steady inflow of a Newtonian, incompressible fluid to a horizontal pipe perforated with circular orifices along the entire length is considered. Experiments show that perforated pipes have a greater equivalent sand roughness height of the wall compared to nonperforated pipes. At a certain spacing of the orifices, the Darcy-Weisbach friction factor depends on the Reynolds number, wall permeability, and wall roughness height. In some cases the friction factor in perforated pipes was 80% higher than in nonperforated pipes. The equation of motion includes both the effect of the discontinuity of inflow along the perforated pipe and the effect of the lateral inflow angle on the total energy loss in the main stream. The maximum value of the coefficient eta sub p, which describes this influence, is 0.77 and is lower than the theoretical maximum value 1.0. (Author's abstract)
W88-04402

MULTIOBJECTIVE ANALYSIS IN OPTIMAL SOLUTION OF HYDRAULIC NETWORKS,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Meccanica e Aeronautica.
A. Cenedese, F. Gallerano, and A. Misiti.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 133-1143, September 1987.

Descriptors: *Optimization, *Hydraulic networks, *Design standards, *Hydraulic structures, *Hydraulic properties, Flow rate, Mathematical analysis, Costs, Pipes, Flow properties.

The optimal design of closed hydraulic networks with pumping stations and different flow rate conditions is considered. The main difficulties in determination of optimal solutions for such problems are related to: (1) Non-linearity of objective functions and constraints equations; and (2) heterogeneity between construction costs and management costs. In fact it is not easy to consider in the objective function both initial construction costs, which are related to the pipe weight, and management costs, which arise later and are essentially related to the pumping energy. Therefore, it appears to be more reasonable to use multiobjective techniques. These techniques are used in order to define the optimal Pareto set in the space of the objective functions: each step of the sequence was analyzed by reduced gradient methods, with pipe diameters chosen in a range of standard values. The constraints are related to: (1) Minimum values of piezometric head at the nodes; and (2) maximum values of velocities in the branches. (Author's abstract)
W88-04403

MEAN FLOW CHARACTERISTICS OF REDEVELOPING FLOWS,
Jodhpur Univ. (India). Dept. of Civil Engineering.
V. P. Gupta, and K. G. Ranga Raju.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 9, p 1144-1158, September 1987.

Descriptors: *Flow around objects, *Flow properties, *Flow velocity, *Boundary layers, Eddies, Flow profiles, Mathematical analysis, Obstruction to flow.

Turbulent boundary layer flow past a bluff body placed on a boundary is characterized by the formation of a standing eddy just downstream of the separation point and reattachment and redevelopment of the flow downstream of the reattachment point. Atmospheric boundary layer flow past buildings and shelter belts (used in agriculture), the spread of polluted air in the vicinity of buildings, evaporation, and other exchange processes near vegetation cover are some of the practical problems in which the knowledge of the characteristics of a redeveloping boundary layer would be extremely useful. A study was undertaken to study the mean flow characteristics of the turbulent boundary layer disturbed by the presence of an obstacle on a flat surface. Experiments were restricted to the redeveloping boundary layer flow past two-dimensional, sharp-edged fences placed over a flat boundary. Data on redeveloping boundary layer flow past obstacles of other shapes, collected by other investigators, were also used in the analysis. (Author's abstract)
W88-04404

HEAD LOSS IN SUBMERGED DROP STRUCTURES,
Clemson Univ., SC. Dept. of Civil Engineering.
A. A. Fiuzat.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 12, p 1559-1562, December 1987.

Descriptors: *Head loss, *Drop structures, Hydraulic structures, Stilling basins, Hydraulic design, Design flow.

A total of 15 tests was conducted to arrive at a drop structure which was the most economical to build and was hydraulically acceptable. The tested alternatives included a 'conventional' stilling basin of 140 ft (42.7 m) length for the same net drop. In the final selection, the stilling basin was only 60 ft (18.3 m) long; the wingwalls were aligned with the structure walls, with their top elevation dropping to the channel bottom at a 1.5:1 slope. The warped upstream transition was replaced by straight converging walls and the rock downstream of the structure was grouted to 46 ft (14 m) from the end sill to prevent scouring. In cases in which numerous drop structures are needed for channel grade control, substantial cost savings can be realized by using shorter and smaller drop structures that are as effective as the larger conventional structures. Basic information for the design of such structure is lacking at present and should be provided by researchers. (Lantz-PTT)
W88-04411

CRITIQUE OF THE REGIME THEORY FOR ALLUVIAL CHANNELS,
For primary bibliographic entry see Field 2E.
W88-04455

SEDIMENT CONVECTION-DIFFUSION AND BEDFORM LENGTH,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W88-04456

MEASURES OF FLOW INTENSITY AS PREDICTORS OF BED LOAD,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-04457

GRAPHIC ESTIMATION OF PEAK FLOW REDUCTION IN RESERVOIRS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04459

CONTINUOUS CREST PROFILE FOR STANDARD SPILLWAY,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager.

Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 11, p 1453-1457, November 1987. 2 fig, 8 ref.

Descriptors: *Spillway crests, *Spillways, *Flow profiles, *Hydraulic geometry, Hydraulic properties, Mathematical equations, Flow patterns, Hydraulics.

The crest geometry of a standard spillway can be defined by a simple function, which has the advantages of being smooth and having gradually varied curvature. Compared to the crest geometry recommended by the Corps of Engineers, such a formulation allows prediction of all pertinent flow quantities with equations valid for gradually varied flow. The accepted mathematical curve can be regarded as a modification of the Corps of Engineers standard curve, since differences between the two, as far as elevations Z are concerned, are only about 1% of the design head. (Lantz-PTT)
W88-04460

SEPARATED FLOW IN LEE OF SOLID AND POROUS FENCES,
M.B.M. Coll. of Engineering, Jodhpur (India).
V. P. Gupta, and K. G. Ranga Raju.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1264-1276, October 1987. 8 fig, 3 tab, 12 ref, append.

Descriptors: *Flow around objects, *Turbulent flow, *Flow profiles, *Solid fences, *Porous fences, Hydraulic properties, Eddies, Mathematical analysis, Model studies, Flow velocity, Hydrodynamics.

The mean flow characteristics immediately downstream of solid and porous fences submerged in turbulent boundary layers have been studied using two-dimensional fences of different porosities. The flow downstream of the fence within and above the standing eddy was found to be well described by Goertler's half-jet model. The dimensionless spread parameter sigma varied systematically with X/delta sub o and the porosity of the fence, where X = the distance downstream of the point of separation and delta sub o = the nominal thickness of the undisturbed boundary layer at the section of location of the fence. The intrinsic axis from which the coordinates are measured followed a similarity law. The model developed in this paper has been found to be applicable to the flow past solid wedges and quadrant-edged roughness. A method of predicting the mean velocity field downstream of solid and porous bodies is proposed. (Author's abstract)
W88-04463

FREE-SURFACE SWIRLING FLOWS IN VERTICAL DROPSHAFT,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. C. Jain.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 10, p 1277-1289, October 1987. 11 fig, 14 ref, 2 append.

Descriptors: *Storm drains, *Intakes, *Dropshafts, *Storm runoff, *Vortex-flow inlets, *Urban runoff, *Swirling flows, *Vertical dropshafts, Mathematical studies, Flow profiles, Hydrodynamics, Fluid mechanics, Froude number.

The free-surface swirling flows in a vertical dropshaft are governed by two nondimensional numbers: the circulation number and the Froude number. The transition flow problem, in which the diameter of the shaft varies within a short distance, was analyzed using specific energy curves; there exists an analogy between swirling and nonswirling open-channel flows. The flow can be either subundal or superundal. The analytical solution for the gradually varied-flow is obtained by solving the continuity and the vertical and angular momentum equations. The distance where the circulation reduces to 1% of the initial circulation and the distance where the axial velocity attains 99% of the limiting velocity depend primarily on the Froude number. (Lantz-PTT)
W88-04464

MODAL RESPONSE OF RESERVOIRS TO WIND STRESS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04465

8C. Hydraulic Machinery

REDUCING WATER PUMPING POWER COSTS,
Waxahachie, TX.
For primary bibliographic entry see Field 5F.
W88-03612

PRACTICAL EXPERIENCE OF USING A LARGE VACUUM PLATE FOR TESTING SHELF MUDS UNDER WATER,
For primary bibliographic entry see Field 8D.
W88-03622

NEW SELF-LUBRICATING ANTIFRICTION MATERIAL IN HYDRAULIC STRUCTURES,
A. S. Sukhov, N. I. Ivanov, V. M. Mogil'nitskii, P. D. Derlugyan, and V. T. Loginov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 608-612, April 1987. 3 fig, 1 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 44-47, October 1986.

Descriptors: *Hydraulic structures, *Lubricating properties, *Lubricating materials, *Polymers, *Hydrodynamics, *Slide gates, *Friction, *Soviet Union, Economic aspects, Physical properties, Mechanical properties, Plastics, Materials testing, Gates, Abrasion.

The Novocherkassk Polythechnic Institute developed a new material, K-112, on the basis of a material obtained by anionic polymerization of E - caprolactam. The antifriction material K-112 is intended for bushings of the support and travel parts of slide gates of hydraulic structures operating in river water and in the open air at temperatures from -60 to +60 C. The material was tested for frost resistance, temperature and humidity aging, and biological stability. In a subtropical humid climate under natural conditions, tribotechnical and strength properties of the material hardly changed in three years. Tests on the physical, mechanical, tribotechnical, and thermophysical properties and stability of K-112 showed its high operation reliability. The industrial technology of producing K -112 was developed, equipment for its industrial production was manufactured, and technical documents were prepared. (Main-PTT)
W88-03627

UPGRADED WATER SYSTEM PROMISES INDUSTRIAL GROWTH,
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5F.
W88-03631

WAVE-POWERED ELECTROLYSIS OF WATER,
Laitram Corp., New Orleans, LA.
J. M. Lapeyre.
U.S. Patent No. 4,490,232; December 25, 1984. 11 p, 7 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1049, No 4, p 1671, December 25, 1984.

Descriptors: *Patents, *Electrolysis, *Wave action, *Electric power, Ocean waves, High pressure, Electric powerplants, Electrochemistry.

A wave-powered generator provides electricity to a subsurface electrolyzer coupled to gas collector storage vessels which provide pressurized gas. Fresh water is supplied to the electrolyzer through a water-filled standpipe. All power for the water electrolysis plant is provided by the waves. Use of the bottom mounted electrolyzer and gas collection vessels either eliminates or minimizes the amount of pumping needed. This permits almost all of the electrical energy generated due to wave motion to be utilized in the electrolyzer. The electric power generating system includes a tethered floating helix coupled to an electric generator. The helix is automatically aligned with the wave propagation direction. In another mode, linear alternators are mounted for reciprocation on a column which extends through the air-sea interface. Each alternator is provided with a donut-shaped float, such that electric power is generated as each float moves vertically up and down responsive to wave motion. (Cremmins-AEPCO)
W88-03947

PREVENTING CAVITATION IN FRANCIS RUNNERS,
Bharat Heavy Electricals Ltd., Bhopal (India).
For primary bibliographic entry see Field 8B.
W88-04048

GATES FOR THE MRICA HYDRO PROJECT,
Engineering and Power Development Consultants Ltd., Kent (England).
J. R. Self, and R. A. Steele.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 8, p 25-31, August 1987. 6 fig, 1 ref.

Descriptors: *Gates, *Hydraulic structures, *Mrica hydroelectric project, *Hydroelectric plants, *Indonesia, Intakes, Spillways, Culverts, Outlets.

The Mrica hydroelectric project is being constructed in an earthquake zone on the Serayu river in the central province of Java, Indonesia on behalf of the State Electricity Authority of Indonesia, Perusahaan Listrik Umum Negara (PLN). Design problems are discussed and the incorporation of various kinds of gates into the scheme at the diversion intakes, power intake (intake screens, screen headloss detection equipment, screen raking equipment, raking gantry, intake stoplog, intake gate, and gantry crane) and draft tubes, drawdown culvert, spillway and irrigation outlet are reported. (Author's abstract)
W88-04050

QUICK STROKING: DESIGN OF TIME-OPTIMAL VALVE MOTIONS,
Alabama Univ., University. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8B.
W88-04238

ANDEKALEKA GATHERING TUBE HYDROPOWER INTAKE,
Hydro Monenco Consultants Ltd., Montreal (Quebec).
J. L. Gordon, F. E. Parkinson, and B. Rakotondrafara.
Journal of Hydraulic Engineering JHEND8, Vol. 113, No. 8, p 1019-1031, August 1987. 9 fig, 6 ref.

Descriptors: *Andekaleka hydropower station, *Madagascar, *Water supply, *Hydroelectric plants, *Intakes, Hydraulic structures, Powerplants, Dams, Water use.

Tropical rivers often transport a heavy bed load and have a high silt content, and their surface waters carry leaves, twigs, and an occasional tree or branch. Extracting reasonably clean water for a high head power plant usually requires the installation of sand traps, sediment sluices, and leaf skimmers. The work associated with the development and hydraulic model testing of a unique gathering tube intake built into the diversion dam of the 122 MW, 702 ft (214 m) head hydropower development at Andekaleka on the island of Madagascar is described. River water is extracted from the relatively clean mid-flow level, above the bed load and below the contaminated surface waters. Results from an inspection after two years of operation showed only negligible deposits within the tunnel. The quantity of solids taken in will remain small, the quartz content is low, and most of the grain sizes will be <0.2 mm. Therefore, the stainless steel turbines are not likely to suffer any signficant degradation due to passage of the solids. (Lantz-PTT)

W88-04396

8D. Soil Mechanics

NEW DESIGNS OF SPILLWAYS AT EARTH DAMS,
For primary bibliographic entry see Field 8B.
W88-03619

PROTECTION OF BANKS AND ROADBEDS FROM EROSION ON RIVER 'NIPS',
For primary bibliographic entry see Field 4D.
W88-03620

PRACTICAL EXPERIENCE OF USING A LARGE VACUUM PLATE FOR TESTING SHELF MUDS UNDER WATER,
Z. G. Ter-Martirosyan, L. I. Cherkasova, A. G. Paushkin, L. N. Ryabchenkov, and F. A. Novosel'skii.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 585-588, April 1987. 3 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 25-27, October 1986.

Descriptors: *Muds, *Load-carrying capacity, *Soil strength, *Soviet Union, *Soil properties, *Compaction, *Shear strength, *Compression, *Bottom sediments, Foreign research, Testing, Surface layer, Engineering, Benthos, Pumps, Filters, Pipes.

When constructing hydraulic structures on a shelf of thick muds with an inhomogeneous structure over the depth, a layerwise determination of the deformation properties of the bottom sediment must be made. A vacuum compaction method, design of a vacuum plate, and methods of testing saturated muds under water for determining their modulus of deformation were developed. The developed testing method advantages are that it does not require a special loading device, the area of the plate is practically unlimited, upward yielding of the soil from under the plate is eliminated, and time to settlement stabilization is accelerated. Testing was carried out in the following order: The plate was lowered to the bottom (ejector pipe in a vertical position). The pump was turned on and water exited the vaccum chamber through the elbow of the vertical pipe ejector. The prescribed increment load was regulated by the pump delivery. Settlement on the plate was measured every 10, 20, 30, 60, 90, 120, and 150 minutes and there after every hour. After injecting air into the vacuum chamber and detaching it, the bottom plate was raised to 1-2 m from the surface. The upper part of the pipe was removed and the plate was hoisted onto the deck. Data obtained in the experiment were used for determining the modulus of deformation of the surface layer of muds. Tests showed that the construction of the plate and its main parts are reliable. (Main-PTT)
W88-03622

UNIQUE SHORING EQUIPMENT INCREASES TRENCH SAFETY,
Addison Water Pollution Control Dept., IL.
For primary bibliographic entry see Field 5D.
W88-03632

ROLE OF LATERAL STRESSES ON SOIL WATER RELATIONS IN SWELLING CLAYS,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W88-03879

8E. Rock Mechanics and Geology

STOPPING SEEPAGE,
V. Fairweather.
Civil Engineering CEWRA9, Vol. 57, No. 3, p 44-46, March 1987. 3 fig.

Descriptors: *Dam stability, *Seepage, *Dams, *Navajo Dam, *Tunnel construction, *Abutments, *Foundation failure, Cutoffs, Engineering, Drainage, Concrete, Erosion, Embankments, Economic aspects, Boreholes, Drilling, Construction, Tunneling, Maintenance.

A combination of seepage, jointed rock foundation, and erodible core materials could cause the 24-year-old Navajo Dam to fail. To reinforce the dam, a concrete cutoff wall will be built to reach down 398 feet within the dam's left abutment, and a combination tunnel and filtered borehole drainage system will be installed on the dam's right abutment. The concrete cutoff wall will be 450 feet long, extend from the crest elevation 6,108 feet to elevations 5,710 and extend into the left abutment at least 50 feet to encompass the area of concentrated relief jointing. The height varies from 60 to 400 feet. The cutoff wall is being built by slurry-wall construction means. The tunnel drain system includes a 10 foot diameter tunnel running 1,045 feet plus 100 filtered drain holes, from 100 to 600 feet long, to be drilled from inside the tunnel. (Main-PTT)
W88-03607

DAM WATER INTAKE WITH TIERED TUNNELS,
For primary bibliographic entry see Field 8A.
W88-03618

COMPARISON OF THE TENSILE STRENGTH OF CONCRETE AND STEEL-FIBER CONCRETE IN BLOCKS OF A TUNNEL LINING,
For primary bibliographic entry see Field 8F.
W88-03623

DESIGN OF BURIED STRUCTURES IN SQUEEZING ROCK IN TORONTO, CANADA,
University of Western Ontario, London. Faculty of Engineering Science.
K. Y. Lo, B. H. Cooke, and D. D. Dunbar.
Canadian Geotechnical Journal CGLOAH, Vol. 24, No. 2, p 232-241, May 1987. 14 fig, 5 tab, 15 ref.

Descriptors: *Rock squeeze, *Design standards, *Construction, *Pumping plants, *Water supply, *Tunnels, Toronto, Shafts, Geology.

The construction of the Domes Stadium in Toronto necessitated the relocation of the John Street Pumping Station and associated water supply tunnels for the downtown Toronto area. The proposed structures include tunnels, shafts, and a new pumping station built in or founded on rock. The shale rock of the Georgian Bay formation is known to possess high horizontal stresses and time-dependent deformation and at this site contains numerous horizontal fractures filled with clay seams. The results of the site investigation, field and laboratory testing, analysis, and design for the buried structures are presented. Special provisions for 'rock squeeze' for different structures are also described. (Author's abstract)
W88-03754

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BOZEMAN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03912

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, HARDIN 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03913

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, WHITE SULPHUR SPRINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03914

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, BILLINGS 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03915

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, ROUNDUP 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03916

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CUT BANK 1-DEGREE BY 2-DEGREE QUADRANGLE,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03945

MAP SHOWING CONFIGURATION OF THE TOP OF THE MADISON GROUP, CHOTEAU 1-DEGREE BY 2-DEGREE QUADRANGLE, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W88-03946

ROCK FOR BREAKWATER CONSTRUCTION IN WESTERN AUSTRALIA - ITS AVAILABILITY AND INFLUENCE ON DESIGN,
Geological Survey of Western Australia, Perth.
For primary bibliographic entry see Field 8G.
W88-03998

GEOLOGICAL FACTORS IN SPILLWAY TERMINAL STRUCTURE DESIGN,
Water Resources Commission, Sydney (Australia).
For primary bibliographic entry see Field 8A.
W88-03999

HYDROGEOLOGIC CHARACTERISTICS OF THE RAMAPO FAULT, NORTHERN NEW JERSEY,
Chen and Associates, Denver, CO.
For primary bibliographic entry see Field 2F.
W88-04057

GYARMATI PRINCIPLE AND OPEN-CHANNEL VELOCITY DISTRIBUTION,
Guangdong Research Ins., Guangzhou (China).
For primary bibliographic entry see Field 8B.
W88-04265

CONDITIONAL SIMULATIONS OF FLUID FLOW IN THREE-DIMENSIONAL NETWORKS OF DISCRETE FRACTURES,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 2F.
W88-04308

8F. Concrete

STOPPING SEEPAGE,
For primary bibliographic entry see Field 8E.
W88-03607

COMPARISON OF THE TENSILE STRENGTH OF CONCRETE AND STEEL-FIBER CONCRETE IN BLOCKS OF A TUNNEL LINING,
M. Z. Kagan.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 589-591, April 1987. 1 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 27-29, October 1986.

Descriptors: *Tensile strength, *Concrete, *Reinforced concrete, *Tunnel construction, *Tunnel linings, Materials testing, *Soviet Union, Steel, Strength, Foreign research, Tunnels, Concrete blocks.

Circular reinforced concrete tunnel linings have found wide use in the construction of subway tunnels and other underground structures. The use of steel-fiber concrete as the lining material instead of existing reinforced concrete is distinguished by higher indices of crack resistance due to the increased values of tensile strength. Blocks were sawed into standard specimens and standard tests for materials (concrete) and articles (blocks) were used. The tests gave a clear idea about the properties of the materials in the articles. Tests results for the tunnel linings showed that steel fibers affected relative strength. If the fibers were not entangled, there was an increase in the homogeneity of the results compared with concrete. If fibers were entangled, different areas of the block gave different results. Introduction of fibers lead to a change in the character of the distribution of strength over the length and width of the block. (Main-PTT)
W88-03623

RHEOLOGICAL PROPERTIES OF DISPERSED CEMENT GROUTS,
V. A. Ashikhmen, and L. E. Pronina.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 10, p 598-603, April 1987. 6 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 34-38, October 1986.

Descriptors: *Rheology, *Cements, *Non-Newtonian flow, *Grouts, *Concrete, *Dams, *Shear stress, *Viscosity, *Hydraulic models, *Fluid mechanics, *Soviet Union, Foreign research, Materials testing, Comparison studies, Hydraulics, Pumping, Velocity gradient, Friction, Engineering, Construction joints, Flow, Stress.

Bench tests were conducted to study the rheodynamics of dispersed cement grouts during their movement along pipes of different diameters. The main rheological properties of these grouts were established. The tests were conducted on devices in which the character and regime of movement of the cement grouts corresponded to actual field conditions making it possible to obtain data for hydraulic calculations of grouting systems. It was determined that pumping of cement grouts through pipes of different diameters showed a ubiquitous decrease of pressure losses along the length (and accordingly a considerable improvement of pumpability) for dispersed grouts compared with undispersed. After dispersing grouts the indices of dynamic shear stress and non-Newtonian viscosity of the grouts decreased. Dispersion of grouts with up to three passes through the disperser did not effect the strength indices of the hardened cement. (Main-PTT)
W88-03626

CAST-IN-PLACE PIPE PROCESS SAVES TIME AND MONEY,
For primary bibliographic entry see Field 8A.
W88-03629

ROLLED CONCRETE DAMS USING GAP-GRADED AGGREGATE,
J. W. Hilf, and F. Asce.
Journal of Construction Engineering and Management JCEMD4, Vol. 113, No. 1, p 27-33, March 1987. 1 fig, 1 tab, 11 ref.

Descriptors: *Concretes, *Concrete construction, *Dam construction, *Roller-compacted concrete, *Dams, *Gap-graded concrete, Seepage, Concrete dams, Costs.

Roller-compacted concrete dams, in which the concrete is placed and compacted in thin layers from abutment to abutment without interior formwork, are very economical. Potential problems of seepage along lift lines, temperature and drying shrinkage cracking, and segregation of aggregates may be minimized or eliminated by the use of gap-graded aggregate concrete. This type of concrete consists of a skeleton of single size coarse aggregate, the voids of which are filled with a graded fine aggregate, cement, and water. The maximum size of the fine aggregate is one-eighth of the minimum size of the coarse aggregate and the very fine sand is eliminated to reduce the specific surface of the aggregates, thereby minimizing the water and cement requirements. The resulting material is a minimum slump, very dense concrete with low cement content. The proportioning method for the concrete mix is straightforward, depending only on the compaction characteristics of the aggregates, the specific gravities of the materials, and the water-cement ratio needed for design strength. The advantages of gap-graded aggregate for roller compacted concrete dams warrant the extra crushing or screening required. The U. S. Army Corps of Engineers is constructing its second roller-compacted dam while the U. S. Bureau of Reclamation has one under construction. Savings in cost as much as 50% for the mass concrete is claimed for this new construction method. (Ray-PTT)
W88-03833

CONCRETE PILLARS AND TRIAXIALLY PRESTRESSED ANCHORAGES FOR LARGE RADIAL GATES,
Porto Univ. (Portugal). Faculdade de Engenharia.
A. Alvares Ribeiro.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 8, p 21-24, August 1987. 6 fig, 12 ref.

Descriptors: *Concrete pillars, *Anchorages, *Radial gates, *Hydraulic structures, Prestressed material, Spillways, Concrete construction, Concrete dams.

The design of pillars and anchorages for radial gates of spillways associated with a number of concrete dams on the Douro river in Portugal is discussed. The dimensions of the Regua gates (the largest of those discussed) led to the adoption of an anchorage scheme in triaxially prestressed concrete. It is a different concept from that which was common at the time, and proved to be an efficient, safe and economical one; it was therefore subsequently adopted for the Valeira and Pocinho projects, where thrusts are very high. (Author's abstract)
W88-04049

8G. Materials

NEW SELF-LUBRICATING ANTIFRICTION MATERIAL IN HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8C.
W88-03627

RECONSTRUCTION OF ASPHALT SHAFT WATERBARS OF CONTRACTION JOINTS OF SECTIONS OF THE POWERHOUSE AT THE LOWER KAMA HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W88-03628

LONG-TERM DEFORMATION AND FAILURE OF BURIED PLASTIC PIPES,
LUTAB A.B., Bromma (Sweden).
E. Hjelmquist, and B. Storakers.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 113, No. 7, July 1987. 16 fig, 2 tab, 19 ref.

Descriptors: *Plastic pipes, *Pipes, *Deformation, Polyvinyl chloride pipes, Construction material, High-density polyethylene pipes, Design criteria, Pipes, Creep.

The mechanical behavior of plastic pipes buried in a trash and subjected to gravitational loading by the trench fill was investigated. The pipe materials of interest, particulary with regard to sewers and drains, are polyvinyl chloride and high-density polyethylene. The analysis was confined to planar behavior and carried out with a two-dimensional finite element of the pipe-trench system, taking kinetic nonlinearities fully into account. The pipe materials are modeled as linear viscoelastic, and trench materials as linear elastic, although plastic and viscous effects are estimated. For a realistic range of material parameters, stresses and deformations arising in the system with time were determined. The time-dependent pipe deformation during 50 yr is of approximately the same magnitude as the initial deformation. Creep predominates for backfill module of less than 1 N/sq mm. A decrease of the backfill modulus by a factor of 10 doubles the maximum pipe strain at a given compression. In all circumstances, an initial relative compression of a vertical pipe diameter of less than 0.06 corresponded to a safe 50-yr design. (Ray-PTT)
W88-03684

UNEXPECTED CONSEQUENCES OF THE CONSTRUCTION OF A STORAGE DAM IN A DESERT COASTAL ZONE IN PERU (CONSEQUENCES INATTENDUES DE L'EDIFICATION D'UN BARRAGE-RESERVOIR EN ZONE COTIERE DESERTIQUE AU PEROU),
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 2H.
W88-03762

ROCK FOR BREAKWATER CONSTRUCTION IN WESTERN AUSTRALIA - ITS AVAILABILITY AND INFLUENCE ON DESIGN,
Geological Survey of Western Australia, Perth.
R. P. Mather.
Engineering Geology EGGOAO, Vol. 22, No. 1, p 35-44, September 1985. 2 fig, 7 tab, 2 ref.

Descriptors: *Rocks, *Breakwaters, *Australia, Rock properties, Wave action, Rock mechanics.

Small-boat harbors protected by rubble-mound breakwaters are currently being built along the exposed western and southern coasts of Western Australia. The limiting factor that determines such a breakwater's ability to resist a wave of a given height is the specific gravity of the rock used for its armor. Blocks of rock in excess of 10 ton cannot usually be economically quarried, carted, or emplaced. In general, this means that the maximum wave height that can be resisted by 10 ton armor blocks of rocks is 4-5 m. For rubble-mound breakwaters using such blocks, 4-5 m waves mark the upper limit of performance without failure. So far, 10 ton blocks have been adequate for the provision of small-boat harbors in Western Australia. In locations where wave heights may exceed 4-5 m, alternative structures must be considered. Particular reference is made to the special problems produced by the remoteness of heavy armor material from the sites of 67% of breakwaters recently built or being considered in Western Australia. Fuller geotechnical investigations for quarries are warranted in these circumstances. (Lantz-PTT)
W88-03998

8I. Fisheries Engineering

MICROBIOLOGICAL CONTENT AND HEALTH EFFECT OF FISHPONDS ENRICHED WITH WASTEWATER EFFLUENT,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, N. M. Noe, and B. Fattal.
Water Science and Technology WSTED4, Vol. 18, No. 10, p 211-218, 1986. 7 tab, 7 ref.

Descriptors: *Wastewater disposal, *Water pollution effects, *Fish farming, Enteroviruses, Coliforms, Bacteria, Pollutant identification, Viruses, Public health, Pathogenic bacteria, Diseases.

This study was carried out from July to December 1980 on kibbutzim (cooperative agricultural settlements) in Israel to determine the microbiological quality and health effect of fishponds enriched with human wastewater. Ponds on 7 kibbutzim were sampled, two of which were chosen for intensive study; one used domestic wastewater effluent as a fish pond supplement, while the other used only animal waste as a supplement. Thirty-eight water samples were assayed for total and fecal coliform. The u of wastewater in the ponds did not consistently increase the levels of the indicator bacteria, in comparison with unenriched ponds. Fish were assayed for coliform and fecal coliform levels in their intestinal tracts and muscle tissue. No consistent difference was found as a result of wastewater enrichment. Salmonella strains were isolated from ponds or fish not exposed to human wastewater, while enteroviruses (poliovirus) were isolated from waster from a pond enriched with human wastewater. Analysis of morbidity data showed no significant excess in enteric disease rates among the total population or among fishpond workers on kibbutzim using wastewater for fishpond enrichment, in comparison with kibbutzim not using human wastewater in their fishpond. (Authors' abstract)
W88-03583

HYDRAULICS OF TWO-LEVEL DENIL FISHWAY,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W88-04273

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

GRADUATE EDUCATION IN WATER RESOURCES: AN INNOVATIVE APPROACH. PART II: POST-PRODUCTION TECHNIQUES,
Arizona Dept. of Water Resources, Tuscon. Tucson Active Management Area.
V. C. Welford, R. A. Block, and J. W. Bulkley.
Water Resources Bulletin WARBAQ, Vol. 23, No. 5, p 803-807, October 1987. 3 tab, 3 ref. Michigan Sea Grant College Program Grant NA-80AA-D-00072 and Project No. E/GLE-7.

Descriptors: *Graduate education, *Videotapes, *Water resources education, *Education, Communication, Water resources development, Resources development, University of Michigan.

The production of a documentary video in a graduate seminar offers advantages over the traditional term paper. These advantages derive from the nature of the videotape medium. The most distinct difference between a written document and a video production is the use of the video camera to record events. In using the camera, the student is required to become involved in front of the video camera, for example, as an interviewer, and behind the camera as a camera operator. Next, as an editor, the student is required to review the events that she/he taped for inclusion in the final product. By participating in these three roles, the student has the opportunity to learn interviewing skills while interacting with professionals in the field, to learn videotaping skills, and to see him/herself as he/she appears to others. The student can use the video feedback to improve his/her professional presentation; posture, dress, gestures, speech, and facial expressions all have an impact on how we are perceived by others. Additionally, the painstaking process of reviewing the taped material leads to an intimate knowledge of the topic, and the process of choosing portions out of entire interviews hones the ability to select the crucial or central themes and ideas from any discussion. Finally, the power of video lies in its ability to communicate information to a wide audience. Although the nature of video for the general public does not permit highly detailed or rigorous coverage of any topic, it is a major source of information. Accordingly, video is an important tool that can be used to inform the public about the importance of wise water resource management. (Author's abstract)
W88-04280

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1985 PROGRAM REPORT (MASSACHUSETTS WATER RESOURCES RESEARCH CENTER),
Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-159471/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. G-1023-01, August 1986. 26 p, 1 fig, 4 tab. Contract No. 14-08-0001-G1023. Project No. USGS G-1023-01.

Descriptors: *Water Resources Institutes, *Massachusetts, *Grants, *Technology transfer, *Information exchange, Acid rain, Acidity, Trees, Forest soils, Bogs, Wetlands, Information systems, Information retrieval, Geohydrology, Geography.

Support for the FY85 research program of the Massachusetts Water Resources Research Center from the Geological Survey was greatly supplemented by Massachusetts state agencies and the University. Three projects were funded through the USGS Water Resources Institute Program. One project, 'A Biogeochemical Model of Sulfur Storage and Export in a Freshwater Bog', attempted to document the long term deposition of sulfate in the Northeast. Results indicate that dry deposition is of equal magnitude to wet deposition and that the principal storage form of sulfate in the bog is as metallic sulfate. A second projects, 'Ozone and Acid Precipitation: Effects on Mycorrhizal Formation and Growth of Watershed Tree Seedlings', continues previous work on the combined effect of ozone and acid precipitation on tree seedlings. Higher levels of ozone and acidity reduced growth, but there were no synergistic interactions between the two pollutants. A third project initiated the development of 'A Geographic Information System for Environmental Resource Data'. The limited GIS developed for this project will include appropriate areal data and innovative uses of GIS data. The information transfer program of the Center provided many periodical publications, reports to the media, and five research reports. (Kaynor-U. Mass)
W88-03496

FISCAL YEAR 1985 PROGRAM REPORT (MICHIGAN INSTITUTE OF WATER RESEARCH),
Michigan State Univ., East Lansing. Inst. of Water Research.
J. F. Bartholic.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-159422/AS. Price codes: A03 in paper copy, A01 in microfiche. Publication No. G-1024-01, September 1986. 29 p. Contract No. 14-08-0001-G1024. Project No. USGS G-1024-01.

Descriptors: *Michigan, *Information transfer, *Research training, Groundwater, Management, Sedimentation, Modeling, Mathematical models, Sediments, Water quality data, Groundwater management, Management planning, Land disposal, Hazardous chemicals, Groundwater pollution, Groundwater migration, Economics.

A major thrust of the Michigan Institute of Water Research's during the 1985 program year involved activities related to its research program, statewide water resources planning activities and the technology transfer program. Water management planning along with surface and groundwater contamination problems are the top priority issues in the state at the present time. Research projects funded by the Institute of Water Research to address these problems and issues include: the problem of clay liner permeability; a computer simulation model schedules irrigation and nitrogen fertilizer applications to minimize nitrate leaching; the dose-response relationship between tetrachlorodibenzodioxin (TCDD) and tetrachlorodibenzofuran (TCDF) for Great Lakes salmonid fish; a model to estimate the economic value of the water resources of Michigan; and support for the Institute of Water Research's Technology Transfer program. (USGS)
W88-03497

FISCAL YEAR 1985 PROGRAM REPORT (STATE OF WASHINGTON WATER RESEARCH CENTER).
Washington State Water Research Center, Pullman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-159414/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1051-01, August 1986. 25 p. Contract No. 14-08-0001-G1051. Project No. USGS G1051-01.

Descriptors: *Research, *Information transfer, *Water resources research, *Washington, Training, Water conservation, Water use, Water costs, Economic aspects, Consumptive use, Evapotranspiration, Irrigation requirements, Water requirements, Mathematical analysis, Closed-conduit flow, Steady flow, Fish passages, Fish migration, Adsorption, Water treatment, Wastewater treatment, Mathematical models, Drinking water, Groundwater pollution, Water law.

Water is a major resource in the Pacific Northwest and the State of Washington. Nineteen dams and hydropower systems provide 80 percent of the power needs of the region. Water from the Columbia-Snake River watersheds irrigate over 4.9 million acres of farmland, with another 1.2 million acres being considered. The 50,000 miles of streams and 8,000 freshwater lakes play a major role in the social, recreational, and economic structure of the state. Recent droughts have shown that under low-water conditions allocations are not sufficient for all users. A major commitment of the state water agencies and the public is to preserve the migration of anadromous fishes in the Pacific Northwest rivers. High erosion rates, agricultural drainage, and increased use of rivers for water transportation and recreation as well as for industrial and municipal wastes disposal are reducing the surface water and groundwater quality in the state. It has also become apparent that there is need to carefully allocate water resources to reduce water use conflicts. This is complicated by the fact that over forty state and federal agencies have a voice in management of the Columbia River alone. Mechanisms are being sought through marketplace research to allow for temporary transfer of water use from irrigation to maintain hydropower production during low flow periods. Research efforts aimed at energy, soil, and water conservation by implementation of computer-based irrigation schedules were undertaken. Efforts to mitigate losses of fish during downstream migration were carried out through research to improve fish guidance screens. Methods for removing impurities of water through better understanding of adsorption capacities of carbon were studied. Better understanding of the mechanics of groundwater flow, risk assessment methodologies for potential pollution of groundwater, and development of management strategies are additional priority areas which were investigated. The State of Washington Water Research Center program is directed toward informing, educating, and attempting to solve or mitigate these complex water allocation, use, and reuse issues. (Funk-State of Washington WRC)
W88-03498

FISCAL YEAR 1985 PROGRAM REPORT (TEXAS WATER RESOURCES INSTITUTE),
Texas A and M Univ., College Station. Water Resources Inst.
W. R. Jordan.
Available from the National Technical Information Service Springfield, VA 22161, as PB87-187381/AS. Price codes: A03 in paper copy, A01 in microfiche. Program report B-1046-01. October 1986. 29 p. Contract No. 14-08-0001-G-1046. Project No. USGS G1046-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Texas, Oxygen transfer, Water quality management, Estuarine environment, Rainfall-runoff relationships, Water conservation, Land management, Dry farming, Water demand, Water use, Social aspects, Population, Computer models, Short-term planning, Irrigation, Irrigation efficiency, Soil management, Water management.

The Institute's 1985 program addresses problems related to water resources planning, water quality and efficient use of water in agriculture. A short-term water demand model was developed and tested with excellent results. When applied to Austin, TX, the model accurately predicted water demand for periods up to 3 months and allowed evaluation of effectiveness of a demand management program. Examination of socioeconomic characteristics of Texas cities confirmed the importance of economic status, race/ethinicity and personal attitudes in determining water demand. Socioeconomic variables explained a greater fraction of the variability in water demand in winter months than in summer months. Field testing of a tracer gas technique to determine reaeration rates of estuaries was begun following preliminary tests in the Brazos, San Bernard and Colorado estuaries. Combined with theoretical analyses, this approach is expected to yield results which may be used to predict safe waste loading of estuaries. Further field tests will concentrate on the Colorado estuary. Furrow diking was confirmed to be an effective, low cost technology to enhance rainfall utilization in row crop agriculture. Economic returns from furrow diking on sorghum ranged between $15 and $41/acre/yr. Experimental findings are being extended to other regions of the state through use of hydrologic and crop yield models. Reports on irrigation and water management on the Texas High Plains were summarized and synthesized. Four bulletins and fact sheets detailing water management procedures have been published and distributed. (Jordan-Texas A&M Univ, TWRI)
W88-03931

PROGRAM REPORT FOR FISCAL YEAR 1985 (CONNECTICUT INSTITUTE OF WATER RESOURCES),
Connecticut Univ., Storrs. Inst. of Water Resources.
N. Burke.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-187845/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1007-01. October 1986. 44 p, 37 ref. Contract No. 14-08-0001-G-1007. Project No. USGS G1007-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Connecticut, Surface-groundwater relations, Metal complexes, Groundwater pollution, Leachate, Eutrophication, Lakes, Nutrients, Heavy metals, Electroplating.

Project summaries include: G-1007-02. A Modeling Study of Surface-Groundwater Relations. Results: A test model has been developed linking atmospheric-plant-soil-groundwater data for predictive use in a small watershed. G-1007-03. Chemical and Physical Adsorption of Metals to Prevent Transport. Results: Soil tests of a 20 yr old metal hydroxide lagoon showed little migration of metals beyond three inches of saturated soil. Additional tests using infrared spectroscopy coupled with soil tests showed the metal hydroxides to be highly stable even under conditions comparable to acid rain. G-1007-04. Contribution of Toxic Chemicals to Groundwater from Domestic Sewage Disposal Systems. Results: Volatile organic compounds and hydrocarbons associated with household wastewater discharges entering on-site sewage disposal systems can make their way into groundwater supplies. G-1007-05. Diagnosis of Watershed Internal Phosphorus Loading. Results: It was found that up to 70% of phosphorus based nutrients contributing to algal blooms are released from sediments within lakes. Hypolimnetic withdrawal, hypolimnetic aeration and sediment oxidation methods used as corrective options applicable to lakes where similar problems exist are discussed. G-1007-06. The Electrochemical Recovery of Metals from Wastewater. Results: A design model, considered to be inexpensive to develop and to install has been developed for a porous, fixed, flow-by electrode system with a high potential for use in the metal plating/finishing and allied industries. Refinements of the design are continuing. G-1007-07. Estimating the Potential for In-Lake Phosphorus Loading. Results: This is a comparison project to G-1007-05, and resulted in finding that respirator quotients (RQs) could not be used uniformly to predict phosphorus concentrations. Lakes with high phosphorus concentrations had high ecosystem RQs, but other lakes with high RQs did not necessarily have high phosphorus concentrations. G-1007-22. Newsletter. Distributed three times/year to municipal offices of all 169 Connecticut towns, to all legislators, and to the public on request. These projects support 4 PH.D., 6 Masters, and 12 undergraduates in water resource training. Newsletters and reports are also produced. (Burke-Ct Univ., IWR)
W88-03932

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BIBLIOGRAPHY OF DISSERTATIONS AND THESES ON WATER AND WATER-RELATED TOPICS FROM NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY,
New Mexico Water Resources Research Inst., Las Cruces.
R. G. Myers, and R. P. Herman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-183224/AS. Price codes: A02 in paper copy, A01 in microfiche. Report No. 156. November 1982. 12 p.

Descriptors: *Bibliographies, *Geohydrology, *Mining engineering, Fate of pollutants, Groundwater flow, Drilling, Meteorology, Aquifers.

A bibliography lists dissertations and theses concerning water alphabetically by author and by department of the institute. No annotations or summaries appear. Typical subjects include hydrogeology of specific sites, trace elements in aquatic systems, theoretical studies on water and ice, meteorologic studies, saline water intrusion, pollutant migration in aquifers, mining wastewater treatment, and groundwater flow. (Cassar-PTT)
W88-03935

STABILISATION, DISINFECTION AND ODOUR CONTROL IN SEWAGE SLUDGE TREATMENT: AN ANNOTATED BIBLIOGRAPHY COVERING THE PERIOD 1950-1983,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5D.
W88-03950

10D. Specialized Information Center Services

SUMMARY OF EIGHTEENTH MEETING, INTERAGENCY ADVISORY COMMITTEE ON WATER DATA.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W88-03943

10F. Preparation Of Reviews

HEALTH AND ENVIRONMENTAL IMPACTS OF BROMINATED ORGANICS PRODUCED DURING WASTEWATER DISINFECTION WITH BROMIDE CHLORIDE,
Dow Chemical Co., Midland, MI.
For primary bibliographic entry see Field 5D.
W88-03531

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